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The Value of Labor Saving Devices

THE recognition of the value of labor saving devices in railway maintenance is attested by the report of the Committee on Economics of Railway Labor which included a report on the methods of maintaining motor cars, and one on the economics effected by the use of labor-saving devices, the latter report covering specifically motor cars, weed destroyers, rail cutting, drilling and building-up devices, tie tamping machines, rail layers, ditchers and locomotive cranes. The reports stress the value of these devices in overcoming the effect of limited forces and inexperienced and inefficient labor and the savings that have been made by their use. The report also contains recommendations which are of prime importance to both the users and prospective users of such devices. These concern the need of collecting and analyzing data to ascertain the savings actually accomplished, and also the necessity of a definite plan for their maintenance. Fortified with actual figures as to results, both in units of performance and in costs, the maintenance officer will be in a position to demonstrate the wisdom of investing in devices that will enable him to do this work more efficiently and economically. It is not enough that he know it; the all-important thing is to convince the man who controls the purse-strings.

Effect of Track Conditions

A MANUFACTURER of car trucks recently related an experience bearing on the service rendered by his equipment which points to an untouched field of investigation. It seems that a check of service records on consignments of trucks delivered at about the same time to two different roads disclosed a wide disparity in performance. On one road the trucks were showing an alarming number of failures while on the other their use had been accompanied by almost no breakages of any kind.

This led to an investigation which disclosed that the road on which the trucks were giving poor service was spending much more money for maintenance of equipment (for an equal volume of traffic) than was being spent by the other road. The investigation occupied a considerable period of time during which the manufacturer did considerable traveling over both of these roads with the result of a further observation to the effect that the standard of track maintenance was much better on the road with the good record for his trucks than that on the other.

Are these facts a mere coincidence or do they point to some definite relationship? Herein lies a field for investigation that has received little attention to date. It embraces one factor which must be given some weight in determining the answer to the problem of the most economical design of track.

Conflict of Authority in the Inter-Committee Relations

IN spite of the care with which the plan of committee work of the A. R. E. A. has been developed, instances of conflict between committees arise from time to time. The most pertinent of these concerns the Committee on Rules and Organization, whose work has not infrequently led certain other committees to feel that it was encroaching on their prerogatives. In recent years this committee has devoted considerable time to the drafting of rules for the conduct of various kinds of work by maintenance of way forces and naturally when this concerns some specific operation, such as the erection of a steel bridge or the inspection of concrete masonry, the subject matter of the rules covers the same ground as specifications or rules of practice already developed by one of the other standing committees, although perhaps designed to serve a slightly different purpose. The theory of committee organization is that each standing committee should be composed of men especially versed in the practical field and with this understanding the committee on Rules and Organization is expected to have the co-operation of the proper committee in dealing with any technical subject. However, this has led to some inter-committee friction, presumably because of a difference of opinion as to which committee had precedence in deciding on a point in dispute. It would seem that insofar as the technical phases of any set of rules is concerned, the authority should rest with the particular committee dealing with the technical subject in question rather than with a committee whose work takes it into all fields.

A Splendid Idea

SEVERAL years ago the Tie Committee prepared specifications for ties which were accepted by the association. Since that time these specifications have been adopted in their entirety or in part by a considerable number of railroads. However, they have not been enforced as uniformly as might be desired, with the result that many railways whose executive officers are laboring under the impression that they are securing standard specification ties when as a matter of fact the ties that they are paying for are falling far short of the specifications in many respects. The Tie Committee therefore determined this year to ascertain the extent to which the specifications were being adhered to and to observe the character and extent of the deviations therefrom. In order that they might gather this information first hand they went into several of the important tie producing territories where they observed the kinds of ties being produced and the standards of inspection in force on the various roads. As indicated in the report which they presented yesterday, they found that standard specification ties were being produced in sufficient quantities to demonstrate that they can be secured. They also found that many roads were over-grading their ties and were accepting ties in which decay is well advanced, these conditions being particularly pronounced on certain roads. It is to be hoped that the committee will continue its work of investigation for we believe that it will do much to raise the standards of grading. While the Tie Committee is not endeavoring to undertake to change the habits of any railway, the fact that it is going into the field and observing the standards of inspection of different railways has already been shown to have a beneficial effect on this inspection in some quarters.

What Is the Function of the Standardization Committee?

SEVERAL years ago the A.R.E.A. created a Standardization committee, the duties of which were apparently not very sharply defined. Many supposed the function of the committee would be to endeavor to secure the more universal adoption by the railroads of the standards of the association. However, the committee constituted itself a board of review to pass upon the standards already prepared by standing committees of the association and approved by the association itself. Needless to say, this attitude has not met with the whole-hearted approval of the committees and as a result the Committee on Standardization has made relatively little progress. It would appear that the time has come when the Board of Direction should specifically define the function of this committee and should outline its duties. There is a field for a Committee on Standardization in fostering the more general use of the A.R.E.A. standards. The recommendations of the A.R.E.A. are generally recognized as the best approved practice. Yet a survey of the standards of different railroads will show a surprisingly small percentage of the A.R.E.A. standards in effect in their entirety on those roads. This is, of course, not a true indication of the influence of the A.R.E.A. for in many cases the association's standards have been adopted.

Importance of Association Work

THE fall of the curtain at the close of the annual conventions of the Signal section and of the American Railway Engineering Association is a reminder of some of the important influences that have made American railways what they are. The United States is a vast country, and its railway mileage exceeds that of any entire continent except North America itself. Nevertheless, in spite of many differences in the more or less detailed practices of individual properties, the railways comprising the vast system of the United States, and that of Canada as well, have been developed in general in a uniform way. There are no differences in gage, as on the government railways of Australia; no such diversity of equipment as the railways of even England alone; and the same standard code of train rules, with few exceptions, is applicable throughout the country. All of these things make for efficiency, and all of them are mainly due to the work of associations of railway officers, such as those that met in Chicago this week, which were formed voluntarily and on their own initiative by officers in the same departments of different roads for the purpose of getting together and comparing their practice and adopting better and more uniform standards in the interest of increased efficiency and the improvement of the service. The contribution to efficiency and economy that has been made by the associations of railway officers has been of incalculable importance; and the attendance and the activities of the conventions in Chicago this week showed that the spirit of the founders of the associations still prevails among their successors.

The Railway Age Dailies and the Signal Convention

THE March editions of the *Daily Railway Age* first appeared in 1910, and have been a feature of the sixteen succeeding conventions of the American Railway Engineering Association. Through these editions of the Daily it has been possible to present the committee reports at greater length than could be done in the regular weekly issues. It has also been possible to include at length discussions of the reports on the floor. Even more important, it has been possible through the Dailies to present these reports and discussions with detailed information regarding the exhibit of the National Railway Appliances Association at the Coliseum in a form available for those attending the convention to peruse at their breakfast tables, while copies are also mailed immediately to subscribers to the Daily, not able to attend.

In past years the Railway Signal Association has held stated meetings in Chicago during the week of the A.R.E.A. convention, and as far as practicable reports of these conventions have also been included in the editions of the Daily. During the last four years, however, this association has held its conventions at times when it has not been possible to include reports of them in these Daily issues. As an instance, last year the Signal convention was held on Thursday and Friday of Engineering week, extending beyond the close of the convention of the A.R.E.A. and the exhibit at the Coliseum. Because of this fact it was not possible for the signal men to be served adequately by either the National Railway Appliances Association or the Daily. This situation was corrected this year by the decision of the Signal Association to hold its meeting on Monday and Tuesday. As a result we were able to present detailed reports of the proceedings in the editions of the Daily for Tuesday and Wednesday, thereby bringing the proceedings of this association to the attention of many higher officers who would not otherwise have access to them.

The officers of the Signal section have expressed their appreciation of our publication of the reports of their convention. We, in turn, desire to express our appreciation for the co-operation extended us by their officers, and particularly their secretary, H. S. Balliet.

J. E. Davison, assistant to the chief engineer of the Canadian National, with headquarters at Winnipeg, Man., has been promoted to district engineer of the Manitoba district, with the same headquarters, to succeed A. V. Redmond, deceased.

* * *

Immediately after the adjournment of the convention yesterday afternon the newly formed Board of Direction met to formulate plans for the work of the association during the ensuing year. The meeting was presided over by President-Elect C. F. W. Felt.

* * *

H. B. Pflasterer, formerly sales representative of the Hazard Manufacturing Company, with headquarters at Chicago, received notification yesterday of his appointment as railroad sales engineer, with headquarters at Chicago, for S. F. Bowser & Co., Inc., Ft. Wayne, Ind., manufacturers of oil pumping equipment.

* * *

An interesting feature of the Thursday morning program was the calling to the platform by President Fairbairn of L. W. Baldwin, president of the Missouri Pacific, and a newly elected director of the association. Mr. Baldwin has long taken a keen interest in the activities of the association, which interest he expressed in brief remarks.

* * *

A. R. E. A. Members Oppose Metric System

Among the representatives of the railways which appeared before the House committee on Coinage, Weights and Measures, on March 4, in opposition to the Britten bill to establish the metric system by January 1, 1935, were three members of the A. R. E. A., John R. Leighty, special engineer on the Southern, John V. Neubert, engineer maintenance of way of the New York Central, and W. P. Wiltsee, chief engineer of the Norfolk & Western. Mr. Leighty estimated that the adoption of this bill would cost the railways of the United States an additional investment of $332,835,000 and an additional annual maintenance cost of $60,000,000 besides $19,970,000 interest on the additional investment, or a total of $79,970,000 a year. In arriving at these figures Mr. Leighty considered the changes in dimension that would be necessary in the materials used, the confusion that would result from the adoption of the kilometer in place of the mile as a standard measure of distance, the re-calculation of tariffs based on the new units of weights and distance, the changing of standard plans and specifications, etc. It will be recalled that the A. R. E. A. went on record at its 1920 convention as opposed to the metric system.

A Medal Presented to H. R. Safford, Retiring Director

During the presentation of the report of the Committee on Economics of Railway Operation and following the remarks of Director-Elect L. W. Baldwin, President Fairbairn announced that Secretary Fritch desired to make an announcement. Mr. Fritch then arose and said:

"Mr. President, we are about to lose from the Board of Directors a member who has been of great service to the Association during the past 11 years. He has been a tower of strength in the councils of the Board, and has served with distinction in the various positions he has held while a member of the board. H. R. Safford will retire from the Board due to expiration of his term of office at the close of this convention. I wish to offer the following resolution:

"Resolved, By the American Railway Engineering Association in convention assembled that we record our appreciation of the distinguished services rendered by H. R. Safford in the interests of the Association during his long connection with the Board of Direction:

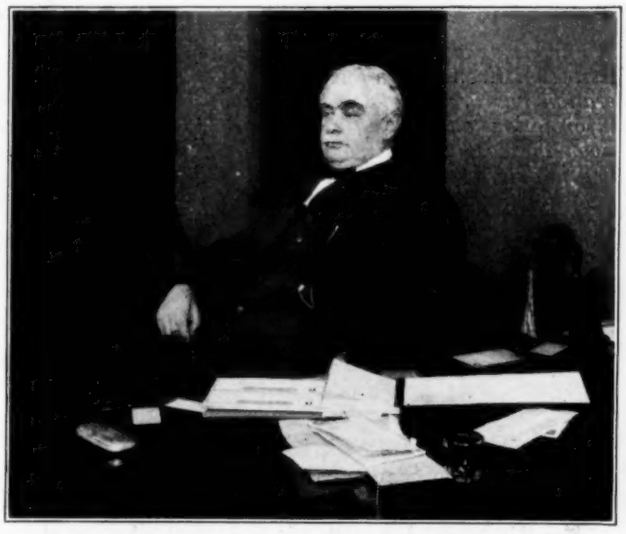
"Resolved, That as a mark of the esteem and regard in which he is held, a medallion be presented to Mr. Safford."

"Mr. Safford, I take pleasure in presenting this medallion to you."

Mr. Safford in accepting the medallion said: "Mr. Fritch, Mr. Chairman and Gentlemen, it is somewhat difficult for me to make a suitable response to this act of kindness and appreciation.

"If I have at any time rendered any service that has any element of value in it, it is an exceedingly small return for what I think this Association has done for me and for the extremely pleasant contact and experience that this membership has meant to me. The 11 years that it has been my pleasure and my honor to be an officer and the 14 years before that of my service within the ranks have been a period of time in which no other influence, I feel, has been as of great value as the work in this body.

"This Association has done more to make railroads better; it has done more to create that degree of fraternity in railroad service, which is one of the outstanding features of the industry. I retire as a member of the Board but I am not retiring as a member of the Association, and while my activities will have to be along more restricted lines I pledge my continuing interest and support."



Secretary C. W. Kelly of the N. R. A. A. at his Desk

Much Line Improvement Work is Being Planned for This Year

A. R. E. A. Concludes Successful Convention

Entire day required to complete work of Association. New officers installed

THE twenty-seventh annual convention of the American Railway Engineering Association was brought to a close late Thursday afternoon by the installation of C. F. W. Felt as president of the association. The attendance was well maintained throughout the entire day, although a considerable number of members left the meeting in the afternoon to visit the exhibit at the Coliseum, which was kept open this year until 6 o'clock Thursday evening.

Reports were presented on Ties; Economics of Railway Operation; Roadway; Wooden Bridges and Trestles; Wood Preservation; Clearances; Economics of Railway Labor and Buildings. Following the presentation of these reports the association entered into its business session, the important feature of which was the installation of the officers-elect.

Report on Economics of Railway Operation

The major work of this year's Committee on Economics of Railway Operation has been the development of information on the effect of speed upon the cost of transporting freight and in determining the methods of increasing traffic capacity by automatic signals and double tracking. The utilization of specific instances for study in developing these reports and the graphical method of expressing the results enhanced the value of the tabulations. Other subjects assigned to this committee, including the cost of starting and stopping trains, and the development of suitable units for comparing operating and maintenance costs were made the subject of progress reports. G. D. Brooke has been chairman of the committee for the last 4 years and a member since 1917.

G. D. Brooke
Chairman

THE committee presented as information reports on the effect of speed of trains upon the cost of transportation (Appendix A) and methods of increasing the traffic capacity of a railway (Appendix B). In addition it offered brief statements of progress on other subjects in four other appendices.

Committee: G. D. Brooke (C. & O.), chairman; J. M. Farrin (I. C.), vice-chairman; E. G. Allen (A. T. & S. F.), B. T.

Anderson (C. & O.), G. E. Boyd (Railway Review), J. M. Brown (C. R. I. & P.), J. W. Burt (C. C. C. & St. L.), W. J. Cunningham (Harvard Univ.), E. J. Correll, H. C. Crowell (Penna.), C. S. Gzowski (C. N.), G. F. Hand (N. Y., N. H. & H.), E. T. Howson (RAILWAY AGE), E. E. Kimball, (Genl. Electric Co.), M. F. Mannion (B. & L. E.), F. H. McGuigan, Jr. (Car Mfgrs' Assn.), H. T. Porter (B. & L. E.), J. F. Pringle (C. N.), W. G. Raymond (U. of Iowa), H. A. Roberts (O-W. R. R. & Nev. Co.), L. S. Rose (P. & E.), Mott Sawyer (C. M. & St. P.), R. T. Scholes (C. B. & Q.), B. J. Schwendt (N. Y. C.), M. C. Selden (C. & O.), V. I. Smart (C. N.), M. F. Steinberger (B. & O.), H. Stringfellow (M. P.), J. E. Teal (C. & O.), Barton Wheelwright (C. N.), J. L. White (A. C. L.), C. L. Whiting (C. M. & St. P.), C. C. Williams (U. of Ill.), Louis Yager (N. P.)

Appendix A—(2) Effect of Speed of Trains Upon the Cost of Transporting Freight

In order to indicate the significance of analysis and data previously submitted, curves are plotted in Fig. 1, showing the effect of speed of freight trains on the major items affected, namely, wages, fuel, maintenance of way and structures, maintenance of locomotives, and fixed charges, together with the resultant curves. Minor items are omitted because they do not appreciably affect the total.

In last year's report attention was called to three cases according to traffic density which would influence the relation between speed and cost of transportation. These cases briefly were:

(1) Where the traffic at hand to be hauled is less than the capacity of the line and equipment available.

(2) Where the traffic at hand to be hauled exceeds the capacity of the rolling stock (either motive power or cars) operated at low speed.

(3) Where the track capacity at low speed is exceeded by the available traffic.

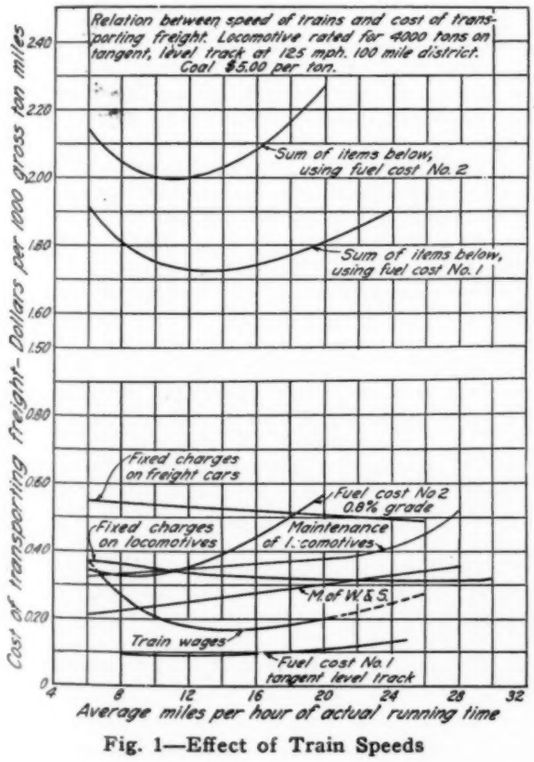


Fig. 1—Effect of Train Speeds

In the case represented in Fig. 1, it is assumed that traffic is at hand to be hauled so that the additional gain in capacity of rolling stock due to increased speed may be realized. The case virtually assumes also that there is no interference from passenger or fast freight traffic. These assumptions render the study of analytic interest, but not directly applicable, except perhaps on industrial roads where drag freight constitutes the entire traffic. The case is predicated on a 100-mile district.

The results are not quantitatively applicable to any one railroad, the data being compositely taken from various sources. The curves show general relationships only.

CONCLUSIONS

The summarizing statements in last year's report may be repeated:

"1. The effect of speed on transportation costs per ton-mile depends upon circumstances of traffic density and physical characteristics of the district considered, viz., ruling grade, length of district, rise and fall, and curvature.

"2. In general, the cost of transportation per gross-ton-mile or per net-ton-mile increases whenever the speed of operation is increased by reducing the tonnage rating below the maximum practical rating."

Conclusion No. 2 is shown to be true by theoretical considerations, by the results of test trains run and by results of normal operation in the cases studied by the committee, where operating costs of drag freight transportation only are considered. However, other factors mentioned above are usually of such magnitude as greatly to modify deductions as to economy of speed based on operating costs only and to limit the application of the above conclusion very narrowly. Studies in economic speeds are complex and must necessarily include inquiries as to effects on operating revenues as well as on operating expenses.

The committee believes that a further study of this subject based on theoretical analyses only will be barren of result and therefore recommends that the subject be discontinued until more observed data under normal operation may become available.

Appendix B—Method of Increasing the Traffic Capacity of a Railway—The Effect of Installing Automatic Signals

A study was made on two Sections A-C and A-E of a railroad. Section A-C is 42 miles long and is a heavy freight district. Section A-E is 66 miles long and is a heavy passenger district. Fig 2 shows the plan and profile of Section A-C and Fig. 3 shows the plan and profile of Section A-E. Both of these sections are single track lines.

Before the installation of signals all trains were operated by train orders and timetables. All meets were by "31" order. Trains were spaced by 10-min. time intervals. Under automatic block rules now in force one train can follow another as soon as the block clears. There was no change in the yard limit rules after the installation of automatic signals. Also there were no marked changes in power or any changes in supervision, sidings, grades, alinement, number of operators or speed limit of trains. Before the installation of automatic signals there were no telephones in use. After installation, a telephone was installed at each absolute signal. This telephone is used for communication between dispatchers and trainmen when trains are blocked by absolute signals.

Operating Conditions and Statistics on Section A-C

	Before Automatics	*After Automatics*
Average distance between train order stations	8.4 miles	8.4 miles
Minimum distance between train order stations	5.5 miles	5.5 miles
Maximum distance between train order stations	10.6 miles	10.6 miles

Average distance between passing sidings	5.3 miles	5.3 miles
Minimum distance between passing sidings	2.7 miles	5.3 miles
Maximum distance between passing sidings	7.5 miles	7.5 miles
Average number of freight trains per day	18	18
Average number of passenger trains per day	8	8
Average adjusted tons per freight train	2019	2027
Average road time per freight train	3 hrs. 26 min.	2 hrs. 55 min.
Saving in road time per freight train		31 min.
Average number of "19" orders delivered per day	44	50
Average number of "31" orders delivered per day	55	0

	Northward	Southward	Total or Average
Number of automatic signals	35	36	71
Average distance between signals	1.15 mi.	1.13 mi.	1.14 mi.
Minimum distance between signals	.6 mi.	.6 mi.	.6 mi.
Maximum distance between signals	1.8 mi.	1.8 mi.	1.8 mi.

The installation of automatic block signals and telephones on the Section A-C resulted in a saving of 31 min. in road time per train. On an average of 18 trains per day for 365 days per year, this resulted in a total saving of 18x365x31, or 203,670 min. road time, or 3395 train hours per year.

Of the above saving in time the following amount can be accounted for in the reduction of train stops.

There was a saving of 55 stops per day on account of eliminating "31" orders, or a saving of 20,075 stops per year at an estimated average of 7½ min. per stop, for 2000 ton-trains at a speed of 15 miles per hour, determined from previous studies, which equals 2509 train hours per year.

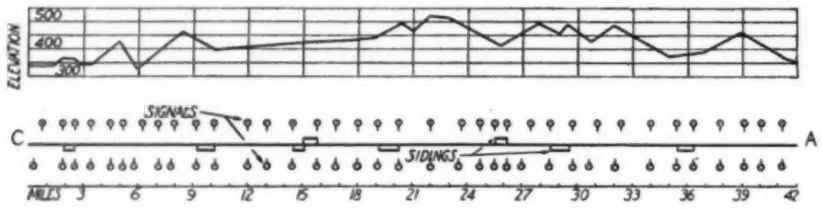


Fig. 2 (Above)—Plan and Profile of Section C-A

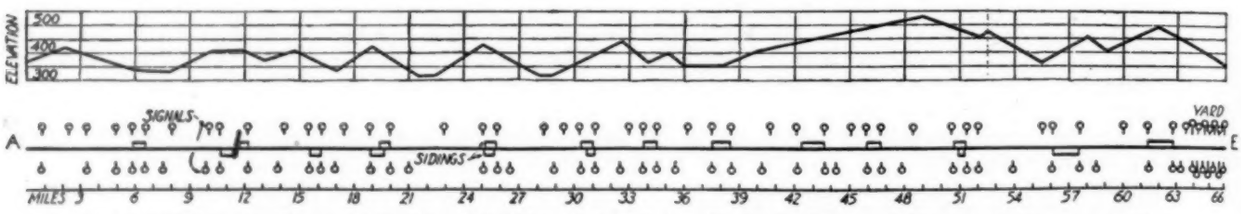


Fig. 3 (Below)—Plan and Profile of Section A-E.

Operating Conditions and Statistics on Section A-E

	Before Automatics	After Automatics
Average distance between train order stations	7.48 miles	7.48 miles
Minimum distance between train order stations	2.0 miles	2.0 miles
Maximum distance between train order stations	14.2 miles	14.2 miles
Average distance between passing sidings	4.8 miles	4.8 miles
Minimum distance between passing sidings	3.3 miles	3.3 miles
Maximum distance between passing sidings	6.4 miles	6.4 miles
Average number of freght trains per day	15.5	15.8
Average number of passenger trains per day	11	10.2
Average adjusted tons per freight train	1500	1567
Average road time per freight train	5 hrs. 30 min.	4 hrs. 26 min.
Saving road time per freight train		1 hr. 4 min.
Average number of "19" orders per day delivered	74	86
Average number of "31" orders per day delivered	80	0

	Southward	Northward	Total or Average
Number of Automatic Signals	54	53	107
Average distance between signals	1.27 Mi.	1.23 Mi.	1.25 Mi.
Minimum Distance between signals	.25 Mi.	.55 Mi.	.40 Mi.
Maximum distance between signals	4.10 Mi.	3.60 Mi.	3.85 Mi.

The installation of automatic block signals and telephones on the Section A-E resulted in a saving of one hour and four minutes in road time per train. On an average of 15.5 trains per day for 365 days per year this resulted in a total saving in road time of 15.5x 365xone hour and four minutes, or 6035 hours per year.

On the above saving in time the following amount can be accounted for in the reduction of train stops.

There was a reduction of 80 stops per day on account of eliminating "31" orders, or a saving of 29,200 stops per year, at an estimated average of seven minutes per stop for 1500-ton train at an average speed of 15 miles per hour, determined from previous studies, which equals 3407 train hours per year.

The following analysis was a process of elimination which brought up and disposed of each factor tending to produce the result of increasing the capacity of the railroad and decreasing the road time after the signals were installed. Items in which there were no changes cancelled out, leaving only those which brought about the increased capacity and reduction in road time.

The factors which brought about the increase in capacity and reduction in road time were about as follows:

(a) Elimination of the 10-min. rule and substituting a much shorter time due to automatic signals.

(b) Possible better movement under the new system in yard limit territory, even though the same yard limit rule is still effective.

(c) The elimination of "31" orders and the substitution to some extent of "19" orders (which under automatic signal protection is ample), the increase in "19" orders not being in proportion to the decrease in "31" orders due to better operation, keeping trains moving, and obtaining better meets.

(d) The improvement in road time of local freights, as under the automatic block system and telephones they can get their information relative to movements of other trains, and can take advantage of it.

(e) Assistance to dispatchers in putting out orders, as they are enabled under the new installation to get more information as to the location and movement of trains.

(f) Betterment to train movement against work extras.

Conclusions

Installation of automatic block signals on a single track railroad will increase the capacity of the road, this increase varying with the length of the division on which they are installed, and with the number of passenger trains operated.

This method of increasing capacity is a very economical one, resulting in a saving in road time on

present traffic, and increased earnings as traffic increases.

In addition to the increase in capacity, the above automatic block signals and telephones provide the following intangible benefits, in addition to increase in capacity of the railroad and the saving in time.

(a) Increased safety.

(b) Increase in the capacity of the train dispatcher, including his ability to manage better, due to cutting the number of train orders in half. (This is of importance on most roads.)

(c) Reduction in damage to loading of cars due to the elimination of 49,275 freight train stops per year.

(d) Reduction in the number of engines and cars to handle the same business in the same time, or the same number of engines and cars will handle a greater business in the same time, the road capacities being increased 38 per cent and 55 per cent respectively.

(e) Increased good will of shippers because more speedy delivery of shipments, permits merchants to carry smaller stocks, the increase in speed in one case being 14 per cent and in the other case 19.4 per cent.

Discussion

[The presentation of the report was directed by Chairman Brooks, who called upon Prof. C. C. Williams (U. of Ill.), as sub-committee chairman to present the report on the effect of speed upon the cost of transporting freight.]

Mr. Williams: In the past year and preceding year, the committee has canvassed the situation with regard to the collecting of data on this subject and attempted various theoretical analyses in addition. The committee seems to have found about all of the data that were available and submits the report as a summary of its findings in which the data have been presented in graphical form.

[After the presentation of the report on speed which was accepted as information without discussion, the course of the committee was interrupted momentarily to recognize the presence of L. W. Baldwin, president of the Missouri Pacific, and also to award a medal to H. R. Safford, executive vice-president of the Gulf Coast Lines and a past president of the association, following whose remarks, commented upon elsewhere in this issue, the work of the committee was resumed with the presentation of the report on increasing track capacity.]

L. J. F. Hughes (C. R. I. & P.): There is a conclusion reached saying that the installation of automatic block signals on a single track railroad will increase the capacity of road. In the report is set up a number of statistics showing that on this test section certain gains were made in operation of the road, but it does not seem clear that we can conclude that the savings made were entirely due to the installation of signals. Is the Committee absolutely sure that the savings shown here can be proven to be due entirely to automatic blocks? Automatic block signals, primarily, it seems, are introduced for an aid to the safety in operation. If capacity can be increased by their adoption, well and good, but it seems to me a very strong conclusion to arrive at unless the thing can be substantiated more fully.

M. F. Mannion (B. & L. E.): I don't think in the report credit is given to the installation of automatic signals for the entire saving that was accomplished after the installation of these signals on these sections. I agree with the remarks just made that the problem is a very complex one.

You will note that the report states the physical characteristics existing before and after the installation of signals and that we have eliminated certain things. In fact the discussion of the report was really a process of elimination, which tended to bring up and eliminate any other change in physical characteristics which might have a tendency to cause increase in capacity or reduction in running time, on this particular section. In addition to the installation of signals on this road, any change in physical characteristics was the installation of telephones and also the elimination or the changing from the 19 to 31 orders.

I think that the data, although it might be interpreted as being rather strong, is sufficient to draw this conclusion that automatic signals will increase the traffic capacity of a railroad. We have not attempted to put a figure on the amount of that increase in capacity due to the signals alone.

L. S. Rose (C. C. C. & St. L.): There was quite a little discussion in the committee over this report, and I am liable to be accused of being the signal man who is against signals, but I am not. There was danger of giving the signals credit for what was not coming to them or which might have been made in another way, and the report was boiled down to cold facts. It is a study. Anybody can draw their own conclusion, but before the signals were installed they were not doing as well as they did afterwards. The telephones were taken into account. A person might say telephone dispatching would increase the capacity of the railroad, but I can argue the other way; but all of these improvements do help the thing along and are entitled to some credit.

Mr. Hughes: I have heard operating men time and again claim that they could get trains over the track faster if it wasn't for the blocks, particularly where you have blocks going out of order and you have freight trains flagging blocks.

As far as the increase in saving is concerned, I also have in my experience known cases where the capacity of the road has been increased by a change in train masters and a good live organization in the operating department.

I really am of the opinion that this Association does not want to make such a broad statement that on single track the installation of automatic blocks will increase the capacity of the road. I think that automatic blocks are a fine thing; they are necessary for the protection of trains. When the traffic gets to a certain point it is necessary to have automatic blocks in order to operate safely, but I do not believe that we want to go on record as saying that installing automatic blocks on a single track railroad is going to make you get more trains over that track.

Mr. Mannion: We have found it true that changes in supervision will materially increase the capacity of a railroad, and in the history of our report we have studied that question and have reported on it. As far as this case is concerned, there is a positive statement in the report that there was no change in supervision. This is a very clean-cut case along that line. We investigated that very thoroughly. You also note that there was no marked change in power, no change in sidings, no change in grades or alinement, no change in the number of operators, and no change in the speed limit of trains. The committee took into account every possible element which might tend to increase the capacity of the railroad on these sections after installation of the automatic signals, and we have found no conditions changed which might tend to bring about

this increase in capacity except the installation of automatic signals and the telephones in connection with the same.

[This portion of the report was received as information without further discussion, after which in order, the other reports were accepted followed by the dismissal of the Committee with the thanks and compliments of the association.]

Report of the Committee on Ties

In an effort to secure comprehensive information concerning the extent to which dating nails or other systems of marking ties are being used the Committee on Ties canvassed the railroads during the past year by means of a questionnaire. The replies from 27 railroads on the influence of such nails on the judgment of persons scheduling tie renewals is a feature of this year's report of the committee. This report was supplemented by a proposed specification for dating nails, while the committee also proposed revised specifications for cross ties and switch ties. Additional reports comprise service reports from railways on substitute ties and remarks on the adherence to tie specifications. W. J. Burton is completing his first year as chairman, prior to which he was a member for 15 years.

W. J. Burton
Chairman

THE committee presented reports covering the following subjects:

(1) Revision of Manual (Appendix A). (2) Report on Use of Dating Nails; Specifications for Dating Nails, and Marking Ties for Service Records (Appendix B). (3) Service Records (Appendix C). (4) Extent to which A.R.E.A. Specifications are being adhered to (Appendix D). (5) Report on Substitute Ties (Appendix E).

It recommended: (1) That the revised specification for cross-ties and the revised specification for Switch-Ties (Appendix A) be approved and the revised text be submitted for the text now in the Manual; (2) That the conclusions in Appendix B, relating to the use of dating nails and the specifications therefor, be approved for printing in the Manual; (3) That the material in Appendix C, relating to service records, be received as information and (4) That Appendices D and E be received as information.

Committee: W. J. Burton (M. P.), chairman; John Foley (Penna.), vice-chairman; F. T. Beckett, (C. R. I. & P.), R. S. Belcher (A. T. & S. F.), E. Betts (S. P.), M. S. Blaiklock (C. N. R.), Bernard Blum, (N. P.), W. A. Clark (D. & I. R.), R. L. Cook (C. of Ga.), E. L. Crugar (I. C.), J. F. Deimling (M. C.), . R. Dewees (P. M.), F. H. Ellsworth (N. Y. N. H. & H.), S. B. Fisher (M.-K.-T.), H. C. Hayes (I. C.), C. S. Kirkpatrick (G. C. L.), R. M. Leeds (L. & N.), R. S. McCormick (A. C. & H. B.), A. J. Neafie (D. L. & W.), G. P. Palmer (B. & O.), F. W. Pfleging (U. P.), L. J. Riegler (Penna.), J. H. Roach (N. Y. C.), S. E. Sims (Sou.), C. U. Smith (C. M. & St. P.), (J. W. Williams (W. P.), W. W. Wysor (U. R. & E. Co.), R. C. Young (L. S. & L.).

Appendix A—Revision of Manual

Proposed Specifications for Cross Ties

The committee presented revised specifications for cross-ties with the recommendation that they be approved and substituted for the specifications now in the Manual. Aside from changes in diction the following changes were made: Under Kinds of Wood the word Fir was eliminated and Douglas Fir, and Fir (True) were substituted; under Resistance to Wear, the text was changed to read: "When so ordered, ties from needle-leaved trees shall be of compact wood throughout the top fourth of the tie, where any inch of any radius of the pitch shall have six or more rings of annual growth"; under Resistance to Decay, it is specified that ties for use without preservative treatment shall not have sapwood wider than one-fourth the width of the tie between 20 in. and 40 in. from the middle of the tie for standard gage ties, or between 15 in. and 25 in. from the middle of the tie for narrow-gage ties, and will be designated as "heart" ties, while those with more sapwood will be designated as "sap" ties; under Dimensions, the lengths of standard gage ties are specified as 8 ft., 8 ft. 6 in., or 9 ft. while the lengths for narrow-gage ties are shown as 5 ft., 5 ft. 6 in., 6 ft., 6 ft. 6 in., or 7 ft. long. Grade O is added to the tabulation of grades, having dimensions of 5 in. thick by 5 in. wide on top. Grades 0 and 1 are not to be accepted in standard-gage ties; under Manufacture, the provision is eliminated that all ties except those of (insert kind or kinds of wood) shall be made from trees that have been felled not longer than one month; under Inspection a clause is added that rafted or boomed ties too muddied for ready examination will be rejected; under Decay, the following is added "in chestnut, 'bark disease' up to ¼ in. deep. 'Blue stain' is not decay and is allowable in any wood"; under the classification of ties which should be treated, firs (true) and "sap" larches are added to Group Tb.

Revised Specifications for Switch Ties

The specifications for switch ties were revised to conform to those of track ties in all particulars except where the difference in size required variation.

Under Dimensions, it is provided except as hereinafter provided all ties shall be 5, 6 or 7 in. thick as ordered, and that ties sawed or hewed on top, bottom and sides shall not be less than 6, 7, 8 or 9 in. wide on top throughout the section between 12 in. from each end of the tie as ordered; the widths for ties hewed on top and bottom only are specified as not less than 5, 6 or 7 in. throughout the section between each end of the tie, as ordered.

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Under Class U, ties which may be used untreated, "heart" black walnut is added to Group Ua and "heart" larches to Group Ub. Under Class T—ties which should be treated "sap" black walnut is added to Group Ta; firs (true), "sap" larches, and spruces are added to Group Tb; and elms and white walnut are added to Group Td.

Appendix B—Specifications for Dating Nails

The committee collected data from manufacturers of dating nails covering types, kinds of material and comparative prices of dating nails manufactured in the past, which was shown in a tabulation. The cost at the factory of the nail now described in the Manual is approximately one-quarter of a cent per nail.

A questionnaire was sent to 60 railroads in the United States. Replies were received from 45 of these roads containing much interesting data. Thirty-two of the roads reported using dating nails to some extent. About 60 per cent of the roads replying to the question as to whether or not dating nails or other means of marking ties was worth the cost stated that the cost is justified.

The committee appended specifications for dating nails and presented the following conclusions which it recommended be included in the Manual, together with the specifications:

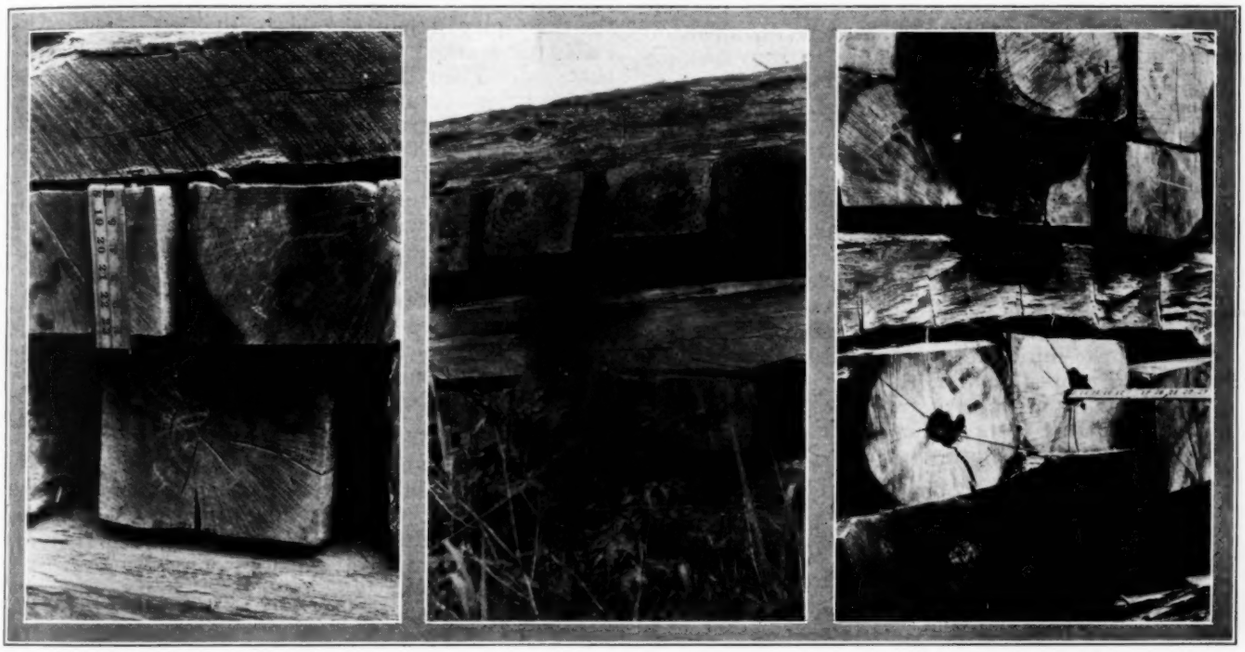
1. A dating nail should be applied to each tie.
2. Dating nails should be driven into the tops of the ties, six inches inside the inner flange of the rail and upon the line side of the track.
3. Dating nails may be applied at the treating plants or after ties are inserted in track. If the latter, dating nails should be driven the same day tie is inserted.
4. It is recommended that ties which are passed through boring and adzing machine be branded on end in addition to the boring and adzing. These brands to include, in addition to two figures representing the year, letters or figures indicating kind of rail for which bored, and letters may be used to indicate kind of wood, or group of woods, and treatment. For example, on one end of the tie "F-90," indicating Fir, bored for 90-lb. rail, and on the other end "A-25," indicating a certain kind of treatment, and the year.
5. In check sections or in any test ties desired, ties may be marked by copper or zinc tags bearing symbol letters and numbers indicating kind of wood, kind of treatment, and, if desired, individual tie numbers.

It was recommended that the conclusions be included in the Manual.

Appendix C—The Extension of Service Test Records for the Purpose of Furnishing Information for the Study of Economics of Ties

In the preparation of service tests it is necessary to first determine the object of the test, and then the test practice can be devised. A consideration of the elements affecting tie life or service led to selecting the following subjects, which should be considered in formulating test practices and records:

(1) Relative advantages of the different sizes of ties: Example—comparison, size 1 with size 3, size 3 with size 5.
(2) Results with different intensities of traffic, other variables being the same.
(3) Relative advantages of different kinds of preservative treatment.
(4) Advantages of pre-boring and pre-adzing ties for treatment.
(5) Relative economies of large and small-sized tie plates.
(6) Determination of density of traffic which makes use of tie plates economical.
(7) Relative economy of cross-ties 8 ft. long compared with ties 8 ft. 6 in. long, under different traffic and ballast conditions.
(8) Relative values of different kinds of wood.



Accepted by the Railroad as a No. 3 tie, although Only 5 in. Thick.

Ties Accepted by the Railroad and Allowed to Season Along the Right-of-Way. Some of the Ties in this Pile Were Too Far Gone when the Committee Saw Them to Warrant Loading Them.

"No. 5" Ties With Two-Foot Scales Inserted for More Than Half their Length in Decayed Hearts.

Conditions Observed by the Tie Committee on Its Inspection of Tie Production Conditions.

A compilation of completed service test records of ties in the annual proceedings indicates that in the past the tests have not provided for all the factors that affect tie life, some of the more important ones not having been covered at all. Neither have tests been devised so as to cancel out the variables other than those the tests were instituted to develop.

It seems evident that, to evolve definite and exact information on any one element, the other variables must be eliminated, and it is proposed to devise test sections for this purpose. For example, ties of sizes 3 and 5, of the same kind, with the same treatment, and equipped with the same size plates, should be tested simultaneously in the same track; ties of the same size, kind, etc., should be tested in adjoining main and sidetracks to develop the effect of traffic.

It is generally conceded that treatment of ties has brought about marked economies, but definite and correct information is not available to prove which method of treatment is the best for given service conditions. The practice of boring and adzing ties before treating has become prevalent, but whether this is economical for all classes of ties cannot be proved from any test data.

In the case of tie plates, all are convinced of their advantages, but there are plates of many sizes in use and there is no data to prove what dimensions, considering cost, are proper. On branch lines of light traffic the use of treated hardwood ties, such as birch and maple, without plates, may or may not be economical and the information indicated by No. 6 above is needed for proper answer.

A considerable mileage of track in this country is now laid with ties 8 feet 6 inches long. Other railways are considering this length, and it is desirable to ascertain if the advantages of the longer ties include longer life.

In the past, most attention has been paid to treatment and kind of wood in connection with tests of tie life, and proper attention has not been paid to cancelling out other variables, such as differences in traffic, size, ballast, subgrade conditions, etc.

The committee recommended that the report be accepted as information.

Appendix D—Adherence to Specifications

With a view to ascertaining the facts regarding tie inspection, two trips of observation were made by the Committee on Ties during 1925. The surveys were made where ties of railroads under observation were accumulated in sufficient quantities to be representative of their stocks in general. The accumulations of ties seasoning at wood preserving plants provided opportunities for seeing inspection and for comparing the results on different roads which would not otherwise be available. Approximately 3,000,000 cross-ties accepted by 15 railroads with over 75,000 miles of line were observed at five concentration points in the Mississippi Valley, from Texas to Minnesota, inclusive.

The 1925 examinations of inspected ties clearly showed:

(1) That ties meeting fully the American Railway Engineering Association specifications for ties can be and were being produced in large numbers.

(2) That on certain railroads practically all ties fully meet the requirements of the A.R.E.A. specifications. The few ties which do not are the negligible errors which are to be expected under the conditions which control inspection.

(3) That certain railroads overgrade their ties. In some cases this is apparently due to carelessness, the ties being overgraded one grade where wane was seemingly overlooked by the inspector. In other cases the overgrading calls 1s grade 3 ties, and 3s grade 5, and is evidently the result of deliberately disregarding the standard.

(4) That certain railroads accept decayed ties. In some cases such ties are degraded on account of the decay. In other cases they are accepted in disregard of the decay, under the assumption that the decay is not serious and that the progress of decay is stopped by preservative treatment.

(5) That certain railroads allow sound ties to decay while seasoning under improper conditions.

During 1926 more inspections of accepted ties will be made. Meanwhile all members of the Association are urged to make observation of their own ties. In the first place, they should insist that each tie be somehow marked to show the grade at which it was accepted. Then the membership will be able to see whether ties accepted and paid for as of a given grade actually meet the standard requirements of that grade. Interest in the character of ties delivered on the part of those responsible for their use would correct much of the fault in the procurement of ties. The overgrading of ties will cease whenever those receiving them question the marking of any which are too narrow or too thin for acceptance at the given grade. The sole object of accepting a grade 1 tie at the price paid by another railroad for a grade 2 or grade 3 tie and of designating such a tie as Grade 2 or Grade 3 is to fool those consuming the ties into the belief that they are getting standard material at market prices.

Appendix E—Substitute Ties

The committee presented reports from railroads making tests of substitute ties, showing changes from the report of last year, together with a tabulation giving data as to their ties. It recommended that the report be received as information.

Discussion

[John Foley (Penna.) sub-committee chairman presented the report on the revision of the specification which after brief explanations on his part of the reasons for some of the recommendations were adopted for inclusion in the Manual. This was followed by the presentation and adoption without discussion of the reports on specifications for dating nails in connection with which Mr. Belcher (A. T. & S. F.), the sub-committee chairman exhibited samples of the different varieties of dating nails in use. Appendix C, on service test sections, presented for information, was adopted subsequent to which the report on the adherence to tie specifications, Appendix D, was presented by John Foley (Penna.).]

Mr. Foley: To come here and adopt specifications and then go home and forget they exist is not engineering. Unfortunately, that has been too true in connection with cross ties. I am sorry all of you could not have accompanied the members of the Committee on Ties who last year visited collections of ties in order to see what is being done.

As you are told in this report, there is a considerable ground for satisfaction, but likewise there is considerable ground for regret. We would like to impress on each and every one of you the importance of your taking an interest, a direct personal interest in the character of the ties that are delivered to you. If you would have your inspection forces mark the ties in such a manner that you can tie up to the individual inspector the character of his work if you will see that

you are supplied with the kind of ties you have asked for, there will be great improvement. It is worse than ridiculous when a railroad will place an order for size 5 ties and say that they shall be 7 by 9 except that they may have one inch of wane. Why they do not order size 4 ties is explained only by the desire on the part of somebody to fool somebody else. Seven by nine tie with one inch of want is a size 4 tie, and you are not going to make a 5 out of it, according to A.R. E. A. standards by calling it a 5, so I would like to impress very much on everybody the necessity for going home and insisting that your ties be labeled and carried all the way through under the A. R. E. A. size standards. Give them A. R. E. A. names, and if you can get along with size 3 tie do not fool yourself or let anybody fool you by calling it a size 4 or a size 5.

[Appendix D was adopted as information without discussion whereupon Appendix E. on substitute ties was also adopted and the committee excused with the thanks of the association.]

Report of the Committee on Roadway

During the year the committee devoted considerable attention to the revision of the Manual and as a result it proposed changes that greatly reduce the subject matter. The committee is presenting for the third time a report on the economics of filling bridge openings which it is now approaching from the standpoint of justifying the expenditure in view of previous controversies. The committee has also presented a report of investigations of corrugated metal culverts for railway purposes, this report giving detailed tests of such culverts under various conditions, and providing also a summary of the results secured from service tests up to the present time. C. M. McVay has served as chairman of the committee for 4 years and has been a member for 10 years.

C. M. McVay
Chairman

THREE subjects were covered in the report presented by this committee: Revision of the Manual (Appendix A), Economies of Filling Bridges (Appendix B), and Corrugated Culverts (Appendix C). The first two were submitted for approval and the last as information. The sub-report presented under Appendix B covers the same ground as matter presented in two previous reports and is omitted here.

Committee: C. M. McVay (N. Y. C.), chairman; J. C. Wrenshall (Reading), vice-chairman; C. W. Baldridge (A. T. & S. F.), H. B. Barry (St. L. S. F.), E. J. Bayer (P. & E.), A. E. Botts (C. & O.), G. S. Crites (B. & O.), C. C. Cunningham (C. R. I. & P.), C. A. Daley, C. F. Hinchman (C. C. C. & St. L.), J. R. Hoagland (C. & A.), W. M. Jaekle (S. P.), J. E. Johnson (P. M.), W. M. Kelly (A. L. & S. F.), R. L. Latham (T. H. & B.), E. C. Oyler (Penna.), O. V. Parsons (N. & W.), J. K. Pettus (N. S.), Blair Ripley (C. P.), G. L. Sitton (Sou.), E. M. Smith (B. & M.), D. W. Thrower (I. C.), H. E. Tyrrell (Sou.), W. D. Wiggins (Penna.), J. R. Wilks (Armco Culvert & Flume Mfgrs. Assn.), W. H. Woodbury (D. & I. R.).

Appendix A—Revision of the Manual

Under this heading the committee presented a long list of revisions, primarily in definitions. However, the most important change was to eliminate a large amount of material now in the Manual on mechanical shovels, cranes, excavators, etc., and operating methods, and offer in place of this the brief statements given below.

Construction Machinery

The use of steam shovels, locomotive cranes, dragline excavators, power ditchers, etc., is constantly increasing on railways; their construction needs to be given attention.

However, as most of such machinery is made by proprietory manufacturers it is not feasible to write definite specifications for their construction. In the purchase of such machines the following points should be given especial attention:

(1) Select machines each part of which is made of the kind and grade of material which is most suitable for that part, be sure that steel is used where steel is needed, special or alloy steels used where such material is best suited for the purpose, etc.

(2) Select a machine which is designed for strength and durability without sacrifice of serviceability.

(3) Select machines which are capable of maximum production.

(4) Select the type of machine which will best serve the conditions under which it is going to be used throughout its lifetime, unless a sufficiently large amount of special work is in sight to justify the purchase of a special machine for the job.

(5) Machines which are to be operated on tracks should, whenever practicable, be built to standard gage.

Operators of Steam Shovels and Kindred Machinery

The fundamental requirements for a successful operator are good judgment in handling loads, ability to keep work moving and care in maintaining the machine.

Appendix C—Corrugated Metal Culverts for Railroad Purposes

As stated in the committee's report for 1924, this work has led to a consideration of corrugated culverts from a standpoint of strength, durability and economy. The following report covers the progress made to date on each of the above subjects.

We have received reports on several thousand culverts, a very large percentage of which are in excellent condition. Our endeavors to obtain information regrading failures have met with little success. A few have been reported, but in some cases the cause of failure has been careless installation. The sub-committee has no report to make at this time on the ques-

tion of relative durability. This inquiry is being continued. The economy of this type of culvert is dependent upon the relative durability and installation costs. Therefore, it must be the last phase of the subject to be developed. The gathering of information will be continued.

A lack of definite information on the pressures to which these culverts are subjected in fill and the strength necessary to withstand these pressures made necessary an investigation of this subject. The results of this investigation are presented herewith as information.

Statement of the Problem

Culvert specifications usually include a requirement for minimum strength as determined by what are known as the two- and three-point bearing tests. For rigid type culverts where failure is evidenced by fracture, the results seem fairly consistent. However, such a method of testing would be of little value in specifying strength for a culvert made of elastic materials. This seems obvious for the reason that in a fill deflection of a flexible culvert results in building up side restraint, thereby assisting the pipe to support its load.

Former investigators have apparently recognized these factors, as is shown by the fact that in tests on the flexible type they have used apparatus that develops side restraint. In all of these tests the sides of the box were rigidly held in place, and it is probable, that due to this artificial restraint the pipe develops a great deal more strength than it would possess under an embankment.

The committee, therefore, concluded that neither the two- or three-point bearing method, nor the method of testing in a box yielded results for the flexible type culvert which could be interpreted into actual installation conditions, unless some study was made of the behavior of the pipe in a fill and an equation factor developed. While the plans were being made for such a study, the committee participated in some preliminary tests, which were made for the purpose of perfecting methods for making the final test under a fill.

The value of side restraint was determined mathematically by Prof. A. N. Talbot, and is fully discussed in the University of Illinois Bulletin No. 22—1908. He shows that for a concentrated load on a thin elastic ring the bending moment may be expressed by $-Mb = 0.159\ Q\ D$, where Q is the concentrated load per unit of length of pipe and D is the diameter. If a vertical load is distributed uniformly the resulting bending moment may be expressed by $Mb = 1/16\ W\ D$ where W = the total load per unit of length of pipe. If, however, the load be uniformly distributed both vertically and horizontally, then the bending moment is represented by $-Mb = 1/16\ (1-q)\ W\ D$, where q is the ratio of horizontal to the vertical load. The committee endeavored to determine the actual value of "q." The vertical load may be assumed to be uniformly distributed. The problem was to determine the relationship between the vertical and the horizontal loads. To solve this problem it is necessary to determine just how the loads in a fill are actually transferred to the culverts. This requires the measurement of pressures on the culverts under actual embankment conditions.

To measure these pressures, a pressure measuring instrument was required which would record pressures at any desired point on the periphery of the pipe. Investigation of available pressure measuring devices led to the selection of the soil pressure cell, commonly called the Goldbeck cell. A diagram of this cell, which was devised by Messrs. Goldbeck and Smith of the U. S. Bureau of Public Roads, appeared in the 1924 Proceedings. It is designed to operate with a diaphragm movement of as little as 0.0001 in. The cell has been used by the Bureau of Public Roads for a number of years and is finding a constantly widening field of use.

The Test at Farina, Ill.

With the preliminary tests completed, and the necessary information and experience obtained therefrom, the committee was ready to make tests under actual service condition. At the same time it was recognized that on construction work the control obtained in the laboratory would be difficult to secure. However, an effort was made to obtain conditions that would give reliable results in the field.

Such conditions were found on the Illinois Central's new line in southern Illinois. The point selected is Station 294, where this line crosses what is known as Crooked creek about six miles east of Farina, Ill. The fill at this point is about 38 ft. high.

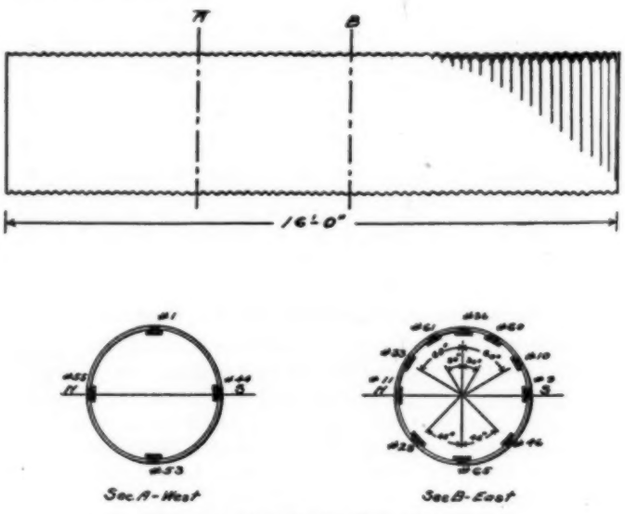
The test culverts comprised eight lines, as shown below.

Farina Test—Location and Description of Culverts

Line No.		*Total Ht Fill*	*Total fill over pipe*
1	42-in. 12-ga. corrugated	8.8 ft. fill	6.0
2	42-in. 12-ga. "	15.0 " "	12.2
3	24-in. x 27-in. concrete*	34.7 " "	32.2
4	24-in. 14-ga. corrugated	34.8 " "	33.1
5	42-in. 12-ga. "	35.8 " "	33.5
6	42-in. Extra heavy cast-iron	37.2 " "	34.2
7	42-in. 12-ga. corrugated	38.7 " "	34.9
8	48-in. 10-ga. " †	37.9 " "	34.6

*Same type and construction as used on I. C. construction.
†Second sheets.

A large number of cells are necessary in a test of this magnitude to insure uniformity in case of slips, faults and variations in compaction of the fill that would be reflected in the readings of a single cell. Sixty-six cells were used. The method of location is shown in Fig. 5.



Location of Cells in Test Culvert.
Line No. 7 42-In. Diameter Corrugated.

Extreme care was taken to see that all culverts regardless of type or diameter were installed under exactly similar conditions. This was essential if the results were to be comparable. The embankment material was tamped to three-fourths the height of the

pipes and at least 14 in. out from the sides. This was done by hand. In some cases culverts were given a different amount of projection above the natural ground in order to determine how much this would affect the loading.

Rainfall data was secured to note what effect, if any, it had on the pressures in the fill. Elevations were

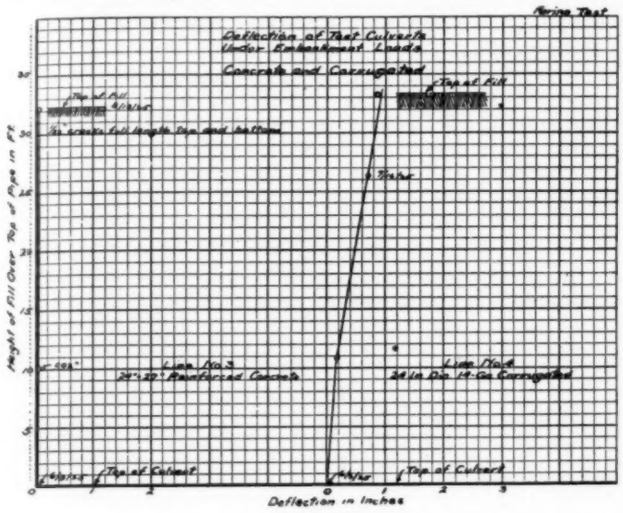


Chart 3.

taken on the top cell of each line so as to note settlement and its effect on the pressures. This settlement is given in Table 5. Deflections were read with an inside micrometer reading to three places.

The material for approximately the first eight feet of filling consisted of a very loose-grained top soil. It was not possible to tamp this material very much as it was very fine and dry at the time of placing. Weighings showed little variation from 85 lb. per cu.

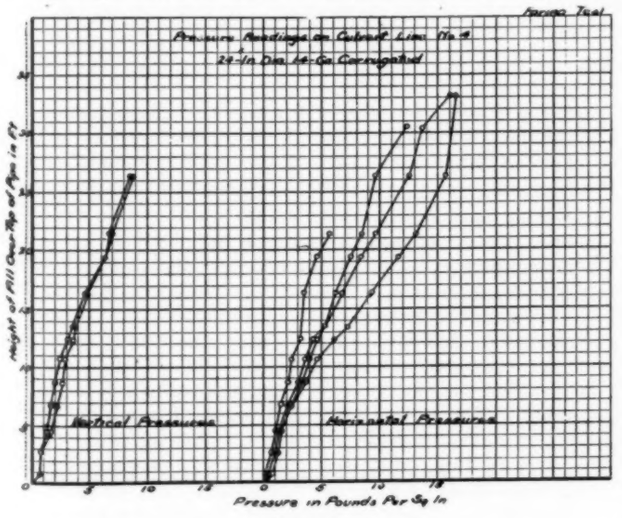

Pressure Readings on Culvert Line No. 6
24-in. Dia. 14-Ga. Corrugated
Vertical Pressures
Horizontal Pressures
Pressure in Pounds Per Sq. In

Chart 6.

ft. and this was therefore taken as representing the average weight in fill up to this height.

Below the top soil the borrow pits yielded a dense and compact yellow clay. This material packed readily and was well consolidated in the fill by the wagons and teams. This part of the fill received considerable rainfall. The clay was so firmly packed that the samples for weighing were taken from the fill in solid blocks. The average weight of this clay was about 112 lb. per cu. ft.

The contractors built the fill in lifts of two feet. After each two-foot layer was placed and leveled off, elevations were taken over each culvert and the pressures and deflections read.

Table 5—Settlement of Test Culverts Into Foundation Up to August 10, 1925

Line No. 5	0.115 ft.
" " 6	0.29 "
" " 7	0.17 "
" " 8	0.18 "

The embankment was placed between June 2 and July 15, 1925. It must be recognized that the average earth fill is not composed of a perfectly homogeneous material. It is therefore to be expected that there will be occasional irregular variations in the unit pressures exerted on the pipes. Considering the amount of the projection of the pipes above the natural soil and the weight of the filling material it seems probable there will seldom be installations where the culvert will be subjected to more severe loading. For

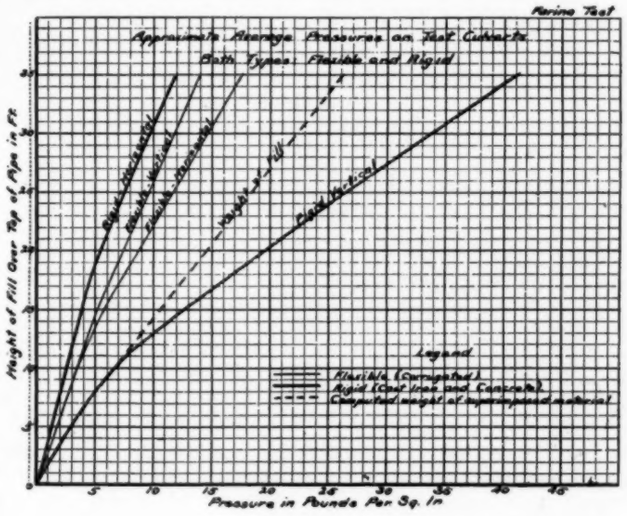


Chart 10.

this reason the deflections shown may be taken as somewhat greater than may be expected under ordinary conditions.

Results of Tests

Curves showing the deflections of two of the culverts at the various depths of fill are shown on Chart 3 giving a comparison of the deflection of the 24-in. concrete with the 24-in. corrugated. The concrete pipe fractured longitudinally throughout its length before the fill was completed, without, however, any marked deflection. The corrugated pipe had deflected 0.8 in. at the completion of the fill.

In the case of the 42-in. diameter 12-gage corrugated pipe with the 42-in. cast-iron pipe, the maximum deflection of the former was 3.062 in., and the latter 0.262 in.; both are still intact.

Chart 6 shows the pressure readings on the 24-in. corrugated pipe. This chart should be compared with Chart 7 showing the pressure readings for the 24-in. concrete. In the case of the corrugated pipe, it should be noted that the side pressures fairly approximate the top pressure, while in the case of the concrete the side pressures are only approximately 30 per cent of the top pressures. Also the top pressures on the corrugated culvert are only about 39 per cent of the top pressures on the concrete, and the side pressures

on the corrugated are about 145 per cent of those on the concrete.

Attention is drawn to the characteristic manner in which the rigid type supports the major portion of the load on its crown and the characteristic manner in which the flexible type distributes the load over its circumference.

Chart 10 shows the approximate average vertical and horizontal pressures for both rigid and flexible types. For comparative purposes, there has been inserted a curve showing the approximate weight of a column of earth one inch square directly above the crown of the pipes. This curve was computed from the actual weight of the material which made up the fill. It will be noted that the vertical and horizontal pressures of the flexible type closely approximate each other, whereas, in the case of the rigid pipe, there is a considerable variation, at the 35-ft. level the horizontal pressure being only about 30 per cent of the vertical pressure. Now, considering the weight of the superimposed material, it will be noted that the vertical pressure on the flexible culvert is always less than the weight of the column above it, while the vertical pressure of the rigid type culvert is always more for heights above 10.5 ft.

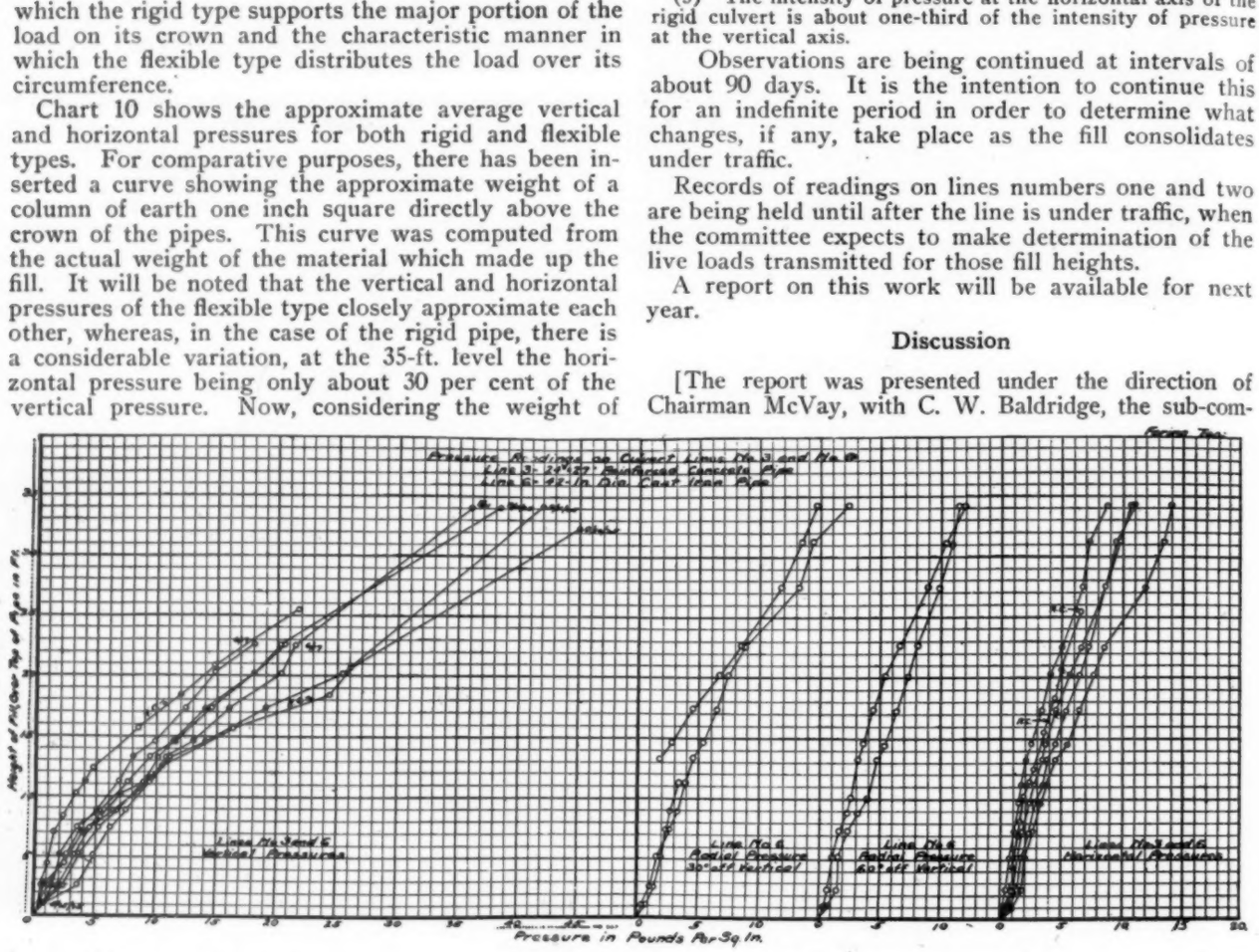


Chart 7.

All of the pipe except the concrete being intact as this report is being prepared, it is impossible to draw definite conclusions as to failure point in the case of corrugated pipe, or fracture point in the case of the cast-iron pipe for fills beyond 35 ft. Based on the information already obtained, further experiments will be made to determine the safe deflection and failure points of the corrugated metal culvert under various embankment loading conditions.

Summary

Results so far show that under the conditions of the Farina Test:

(1) The intensity of vertical pressure measured by the top cells on the corrugated culverts is about one-third of the measured vertical pressure on the rigid type of culvert under the same condition of loading.

(2) The intensity of vertical pressure measured by the top cells of the corrugated culverts is about 54 per cent of the weight of the unit columns of the material above the cells.

(3) The intensity of vertical pressure measured by the top cells of the rigid culverts is about 158 per cent of the weight of the unit columns of the material above the cells.

(4) The intensity of pressure at the horizontal axis of the corrugated culvert is equal to or greater than the intensity of pressure at the vertical axis.

(5) The intensity of pressure at the horizontal axis of the rigid culvert is about one-third of the intensity of pressure at the vertical axis.

Observations are being continued at intervals of about 90 days. It is the intention to continue this for an indefinite period in order to determine what changes, if any, take place as the fill consolidates under traffic.

Records of readings on lines numbers one and two are being held until after the line is under traffic, when the committee expects to make determination of the live loads transmitted for those fill heights.

A report on this work will be available for next year.

Discussion

[The report was presented under the direction of Chairman McVay, with C. W. Baldridge, the sub-committee chairman presenting the work of the committee on Manual revisions.]

H. E. Miller: (C. V.) The word "payment" is objectionable. You look to your contract for your payment and your specifications for your estimate. It seems to me the word "estimates" should be substituted for the word "payment." It reads now, "for which service payment shall be made." It should be changed to read, "for which service estimates shall be made."

Chairman McVay: It is really the same thing. It doesn't state the amount of payment, or anything like that. There is no contract condition there, as I understand it. Your contract would state "for which service payment shall be made at 60 cents per tie," etc. It was the idea of the committee when this was made that the word "payment" was better than the word "estimate."

Mr. Miller: In section 18 (of the Manual) referring to the use of the word "masses" it seems to me that there are only two classes of solid rock, one is rock in solid bed and one is boulders. The definition of a boulder is a mass of rock that has been transported by natural agencies from its native bed. It seems to me that the word "masses" does not add anything there, but if the committee feels that word ought to be left, something should be added to define the word "masses" to show how something else is meant other than rock in solid bed or boulders.

Mr. Baldridge: The definition which is given here does not cover solid rock and it is unfortunate that the term "solid rock" and "loose rock" ever were adopted to designate classification, because a great many people seem to confuse the definition of solid rock classification and the term solid rock.

Just for illustration, assume if we would call this heavy classification and say that heavy classification shall comprise rock in solid beds or places or boulders, measuring one cubic yard or more and all other material which can most economically be removed by blasting, I believe it would cover the classification and would be clearer. However, we left the words "solid rock" in classifying the terms, solid rock classification and loose rock classification in the Manual because it has been customary throughout the construction of railroads in this country.

In eliminating the word "masses" a boulder may be a mass of rock, but the mass of rock is not a boulder. Every one of you who have had very much construction in the mountains at least knows that there is a great deal of material which must be moved and classified as solid rock which is not solid. It is a mass of rock in various shapes and conditions. When you get into the volcanic section of the southwestern part of the United States, there is a class of material generally called malaphi, which is anything in the world but solid rock. It is the hardest thing to move there. You can't drill it successfully. It is very hard, full of seams, and when you get a hole drilled and put in a charge of explosive, very frequently you get almost no results, because of the seams. Almost no contractor, or one of experience, would be willing to move malaphi as cheaply as he would solid granite because it is harder to move.

If we get away from the idea that this is a definition of solid rock and make it the definition of classification, I believe you will find that the wording given by the committee is about correct.

Mr. Miller: It seems to me advisable to do away with the headings "Solid Rock, Loose Rock, Common Excavation," paragraphs 18, 19 and 20 in the Manual and insert the heading "Classification" before paragraph 18 and have paragraphs 18, 19 and 20 come under the word "classification."

The latter part of paragraph 18 provides that all of the material which can most economically be removed by blasting, be classified as solid rock. It seems to me that you have a clause there which may possibly be the cause for considerable trouble.

The contractor can predetermine what his classification is going to be. On the other hand, you tie the hands of your engineer where he can not use his own individual discretion and judgment.

It would be preferable, instead of using that clause, to insert after paragraph 18, a proviso to read something as follows: "All material which can be removed most economically by blasting that does not come under the provision of Section 18 or Section 19 (Manual) shall be classified on a percentage basis as solid rock, loose rock or both, as conditions warrant."

Under that provision, if you have difficult material to handle, your engineer might in one place classify 25 per cent solid rock and in another case five per cent solid rock, according to the difficulty of the material.

Mr. Baldridge: The paragraph, as written, states all other material which can most economically be removed by blasting. I never saw a construction job that had classification in it but what the classification was based on the judgment of the engineer, and I don't see anything here which states that the contractor shall be the judge as to whether it would be most economically removed by blasting or not. That still is in the judgment of the engineer. Any further modification which is necessary or desirable should properly be made in the contract.

J. B. Jenkins, (B. & O.): I suppose the gentlemen who made the objection referred to something like an experience I had about 35 years ago where a contractor had common earth to excavate in a big quarry pit, and he found that an easier way of doing the work was to put in small charges of black powder and shoot the earth instead of picking it. The contractor came to me and claimed solid rock excavation although it was clearly distinctly earth. Of course, I decided it was common excavation. This provision recommended by the committee doesn't place it in the hands of the contractor any more than it was in the hands of the contractor then.

J. L. Campbell, (C. P.): It would be difficult to make any improvement in the specification or the classification of material submitted by the committee. We could discuss this subject all day, and I think we would really make little progress in the way of benefitting these details.

All of us who have had experience in this kind of work know that most of the trouble and disputes under a contract when it comes to the final estimate arise in the classification that has been made. It seems impossible to write a classification or specification that will remove the possibility of trouble in the settlement or the absence of actual trouble in the settlement.

I want to make a suggestion that it not infrequently happens on a particular piece of work that it is quite possible to classify the material before the contract is signed.

[Upon a vote the committee report was adopted without revision, for inclusion in the Manual. The next report, that of the sub-committee on the economies of bridge filling was adopted for inclusion in the Manual without discussion, following which the report on culverts was presented with introductory remarks by the sub-committee chairman, W. H. Woodbury, which are reproduced in part as follows]:

Mr. Woodbury: There are several things that I would like to call attention to which I think may be of interest. As stated in the report, we have made our study on the basis of three main divisions. We have studied it on the basis of durability, economy and strength. We find that under durability we have a great deal of difficulty in obtaining satisfactory information. We received very little information in regard to failures. As I said on a previous occasion, this material has been in use for such a short time that no one can safely say whether or not it is a permanent structural material.

There are four principal manufacturers of this material. Each claims to have a superior material. We are not prepared to say which material is superior, if any is. There have been a good many laboratory tests made, but it is doubtful whether a laboratory test can be considered conclusive. We are following this subject up. We have reports on 1,000 culverts which have been in service from 20 years up until only a year or two, and the vast majority are reported as giving excellent service and in good condition.

In 1910, I had charge of a small piece of railroad construction and installed about 50 corrugated metal culverts. At the time I presumed it was merely a temporary device to be replaced later by more permanent construction. In 1920, 10 years later, I inspected these culverts and found them practically in as good condition as when I installed them. Last year, 15 years after installation, I could see practically no deterioration over the previous inspection.

In regard to economy, we also have acquired a lot of information. Our difficulty is to get absolute parallels. There is no question that initial installation of corrugated

metal culverts in many cases is very much more economical. If the question of durability is decided in their favor, then we have an advantage in using corrugated metal culverts.

We are under obligation to the American Rolling Mill Company for financing and furnishing material for these experiments. They undoubtedly will receive considerable benefit, but the other three chief manufacturers of this material should receive just as much benefit from these experiments on strength.

The Illinois Central Railroad also deserves credit for permitting us to install this experiment on their lines. I want especially to call your attention to the work that J. R. Wilks, a member of this committee and a representative of the American Rolling Mill Company, has done. He planned, supervised and carried through the test which was a very arduous task.

[There being no further discussion, the report on culverts was accepted as information and the committee excused with the thanks of the association.]

Report of the Committee on Wood Preservation

One of the outstanding problems confronting wood preservers has been the treatment of Douglas fir, the extent of its use making it an appropriate subject for attention on the one hand and its resistance to treatment presenting a real obstacle on the other. It is interesting, therefore, that the committee is now presenting specifications for the treatment of this timber. The committee is now carrying on the investigation of marine piling and presented the results of various observations. The year's work also includes a comprehensive report on service test records, the most valuable portion of which is a revised and extended table of cross tie renewals per mile of all tracks on 24 railroads. S. D. Cooper has been chairman of the committee for 3 years and a member for the last 4 years.

S. D. Cooper
Chairman

THE committee presented reports covering: (1) Revision of the Manual (Appendix A), (2) Treatment of Douglas fir (Appendix B), (3) Service test records (Appendix C), (4) Marine piling investigations (Appendix D), (5) Preservative treatment of trunking and capping (Appendix E), (6) Treatment with creosote and petroleum (Appendix F), and (7) Treatment with zinc-chloride and petroleum (Appendix G). The action recommended by the committee was that Appendix A, Revision of the Manual; Appendix B, Treatment of Douglas Fir; Appendix E, Preservative Treatment of Trunking and Capping, be adopted and published in the Manual. The other material was offered as information. Brief abstracts of Appendices A, B, D and G are given below:

Committee: S. D. Cooper (A. T. & S. F.), chairman; F. C. Shepherd (B. & M.), vice-chairman; W. G. Atwood (Cons. Engr.), R. S. Belcher (A. T. & S. F.), H. C. Bell (N. & W.), Z. M. Briggs (Penna.), G. M. Davidson (C. & N. W.), G. F. Eberly (B. & O.), J. E. Fanning (I. C.), H. J. Force (D. L. & W.), C. F. Ford (C. R. I. & P.), E. B. Fulks (Am. Creosoting Co.), Andrew Gibson (N. P.), E. W. Hammond (B. R. & P.), R. H. Howard (Wab.), W. H. Kirkbride (S. P.), J. B. McClain (S. A. L.), J. F. Pinson (C. M. & St. P.), L. J. Reiser (C. R. I. & P.), W. R. Rhodes (M. P.), Frank Ringer (M-K-T), Dr. Hermann von Schrenk (Cons. Engr.), O. C. Steinmayer (Can. Creosoting Co.), J. H. Waterman (C. B. & Q.), J. W. Williams (W. P.), Galen Wood (Conc. Engr.).

Appendix A—Revision of the Manual

The work of the sub-committee consisted of two parts: First, an editorial revision of all of the material on wood preservation appearing in the Manual, given in an Exhibit A. This was simply a revision as to form so as to bring co-related subjects together. Certain changes as to wording had also been made, but in none of the revisions were any changes as to the matter made.

The second part of the committee's work consisted in the report on actual revisions of the matter now in the Manual with changes recommended for adoption. These were of a detailed nature relating primarily to laboratory procedure.

Appendix B—Specifications for the Preservative Treatment of Douglas Fir

(We give below only the introductory statement preceding the actual specification.)

The physical structure of Douglas fir causes it to be refractory to preservative treatment, this quality varying with the conditions under which the timber is grown. The heartwood offers great resistance to the injection of preservative; the sapwood can be treated more readily, but since the natural timber contains only a thin shell of sapwood, the general treatment is difficult. Furthermore, since sawed timber may be entirely heartwood, or may contain only a very small amount of sapwood, it follows that this type of material is more difficult to treat than piling, which contains the full amount of original sapwood.

Perforating or Incising—The refractory quality of Douglas fir has led to the development of the principle of perforating or incising the timber mechanically as an aid to injection of preservatives. The advantages of this procedure have been demonstrated conclusively. Thus far the practice has been confined to tie and pole material. The incisions are so made and spaced that the preservative entering the wood unites between adjacent incisions and produces a more uniform and deeper penetration than would otherwise be possible.

Piling Sapwood—In order to obtain an adequate treatment, all piling material should have a minimum sapwood thickness equal to the depth of penetration desired.

Seasoning Before Treatment—In accordance with the general recommendations of this association for all timber, Douglas fir should be air-seasoned before treatment wherever possible. If this is done, artificial seasoning is avoided, the treating cycle is materially shortened, and a better treatment is secured. The proper amount of such seasoning will vary with climatic conditions and must be determined for each locality by actual tests.

Material stored for seasoning should be piled in accordance with the recommended practice of this association.

Artificial Seasoning—If air-seasoning cannot be secured, the material must be artificially seasoned in order to accomplish treatment. The method of such seasoning will depend upon the kind of treatment. In cases where artificial seasoning is to be secured by boiling the material in the preservative oil, it is important that the specified allowable temperatures be not exceeded, to avoid injury of the timber. In treatments where zinc-chloride is used, the only method of artificial seasoning is that of steaming, and this procedure is not recommended by the association.

Machining, Cutting, Framing—With the exception noted below for processes in which zinc-chloride is used as a preservative, all machining, cutting or framing of timber to be treated should be accomplished before treatment as far as practicable, to minimize subsequent cutting through the treated shell and exposure of untreated wood.

Preservatives—The following preservatives are commonly used for the treatment of Douglas fir: creosote, creosote-petroleum mixture, creosote-coal-tar solution, creosote-zinc-chloride emulsion, and zinc-chloride.

Preservative Treatments—Douglas fir is commonly treated by the following preservative processes: Full cell process, empty cell process with final vacuum, empty cell process with initial air and final vacuum, creosote-zinc chloride emulsion process, and zinc-chloride process.

The selection of treatment is largely determined by the intended use of the treated material. All the above preservatives and treatments have been applied to timber for general inland purposes. Use of timber treated by the zinc-chloride process is limited by conditions of humidity. The full cell process with straight creosote as the preservative is the only treatment recommended by the association for the preservation of piling, and the timber to be used in sea water exposed to the action of marine borers.

Final Retention of Preservatives—The amount of preservative to be retained by the timber is optional with the railroad, within the limitations of the various processes and necessary minimums specified by the association. The amount required will depend largely upon the intended use of the treated material. The following amounts are recommended:

For Douglas Fir Ties and Structural Timber

(For ties and moderate size structural timbers having dimensions over 6 in. and under 12 in. A greater amount of preservative should be injected for timbers having dimensions less than 6 in.; a smaller amount can be injected for timbers in which the smaller dimensions is more than 12 in.).

(a) Treatment by full cell process with creosote, creosote-petroleum mixture or creosote-coal-tar solution—not less than 10 lb. of preservative per cu. ft. of timber.

(This amount is necessary to secure a minimum adequate penetration. A treatment of 10 lb. by the full cell process will give about the same penetration as a 6 lb. treatment by the empty cell process.)

(b) Treatment by empty cell process with creosote, creosote-petroleum mixture or creosote-coal-tar-solution—6 to 8 lb. of preservative per cu. ft. of timber.

(c) Treatment by creosote-zinc-chloride emulsion process—3 lb. creosote and 0.4 to 0.5 lb. dry zinc chloride per cu. ft. timber.

(d) Treatment by zinc-chloride process—0.5 lb. dry zinc-chloride per cu. ft. timber.

For Douglas Fir Piling Not Used in Sea Water

Treatment with creosote—not less than 10 lb. creosote per cu. ft. timber.

For Douglas Fir Structural Timber and Piling Used in Sea Water

Treatment by full cell process with straight creosote—not less than 12 lb. creosote per cu. ft. timber.

Seasoning After Treatment—To secure the maximum benefits of the preservative process it should not be used immediately after being treated. Tie material should be seasoned a minimum of 60 days after treatment.

Appendix D—Marine Piling Investigations

The pertinent files of the Committee on Marine Piling Investigations of the National Research Council were turned over to this sub-committee during the year and the National Research Council also notified the government departments that this sub-committee had succeeded to the work and bespoke the same degree of cooperation which had been previously given to the council. The council also sent a similar notification to the "Committee on the Deterioration of Structures in Sea Water" of the Institution of Civil Engineers of Great Britain. The chairman of this sub-committee called on the Secretary of the British Committee in London and arranged for the same cooperation which had existed with the National Research Council.

This committee, having no funds available for research and being under the necessity of working entirely with contributed services, found itself unable to continue the extremely valuable biological work which had been carried on by the council. It was impossible to do more than to carry on the long-time tests which had already been started and to initiate one series of new tests for which the specimens were prepared and furnished by the Chemical Warfare Service. A final report on the studies of this very efficient government organization is also in preparation and will be submitted to this committee for publication when completed.

The tests now under way may be divided into three general classes as follows:

(I) Tests of various timbers, principally tropical, for which the specimens had been collected and placed under the direction of the Committee on Marine Piling Investigation, and similar experiments being made under the direction of the engineer of maintenance of the Panama Canal and a joint Army and Navy Board at Manila. Several tests of different methods of protection by the same agencies are also included in this group.

(II) Tests of specimens impregnated by the Chemical Warfare Service with materials which their studies had shown to offer the greatest prospect for success.

(III) Tests of specimens impregnated with various creosotes and fractions of creosote which had been treated by several agencies.

These tests have been under way for periods ranging from a few months to several years and it is

hoped that this committee will be able to submit annual reports on their conditions.

Three materials were fixed on as offering the greatest promise from the standpoints of efficiency and economic availability and test pieces were treated with them. Twelve locations were selected for the tests, care being taken to make the tests in both warm and cold water and to have all of them at locations where the two-year tests of the National Research Council had shown great activity by the borers, and in most cases the presence of several species.

Conclusions

Test of cottonwood indicates that probably the bark furnishes the protection and that when this is broken the timber itself has no more resistance than any other.

Angelique and manbarklak are not as yet proven to be immune. None of the specimens of angelique have been attacked, but two of those of manbarklak have been.

None of the specimens of turpentine wood have shown attack beyond the bark and the very thin layer of sapwood. This agrees with the service records previously obtained for this timber.

The period of test for the Chemical Warfare Service specimen is too short to expect any result, but it is interesting to note that the two cheap materials, copper carbonate and fuel oil with a toxic, are as yet unattacked and in most cases little or no marine growth is attached to the specimens.

The failure of the borers to attack the untreated control pieces in most of the test frames is very interesting. It is very unfortunate that funds are not available for scientific studies to find the reasons for these and other very important facts regarding the action of the borers. Money expended on such studies would very probably make possible the development of more efficient protection.

It was recommended that the committee continue the studies now under way.

Appendix G—Treatment with Mixture of Zinc-Chloride and Petroleum

Under conclusions given in the report of last year it was stated that certain operating difficulties were encountered in the experimental work with zinc-chloride and petroleum which had not been very encouraging up to that time.

About 3500 ties were treated in this manner and have been placed in test track. This experimental work has been continued during the past year, chiefly along the line of the zinc-petroleum emulsion treatment described in the last year's report.

This experimental treatment has been carried on during the past year in an experimental cylinder located at Somerville, Tex., and it has been found that with certain petroleums containing sufficient asphalt, emulsions may be made with which southern yellow pine, oak and gum timber may be treated, leaving up to ¾ lb. of zinc-chloride per cubic foot of timber in sappy Southern yellow pine and 0.3 to 0.5 16. in red oak and gum. This zinc-chloride-petroleum emulsion treatment is now being tried out at Albuquerque, N. M., in standard size treating cylinders, but this work is only just under way, and results will not be available for this year's report.

Discussion

[The report was presented by Chairman Cooper. The first report on revising the Manual, contained in Appendix A, being adopted after a discussion, the trend of which was merely that of clarifying terminology. The next report on Specifications for the Treatment of Douglas Fir was adopted in the form presented without discussion except for certain corrections in phraseology which were recommended by the committee. This was followed by the presentation and acceptance without discussion of the report on service tests, whereupon the report in Appendix D, Marine Piling Investigations was presented with introductory remarks by the sub-chairman, Dr. H. von Schrenk, which are reproduced in part as follows]:

Dr. H. von Schrenk: This committee has had rather hard sledding because nobody was willing to do any financing, and the work of the committee is necessarily of such character that it involves a great amount of labor. This year, as indicated in the preliminary paragraph, was devoted to continuing the active research work which had been initiated by the Marine Piling Committee of the National Research Council following the San Francisco disaster many years ago.

I would like to call particular attention to the visit which I had the privilege, as chairman of this sub-committee, of having last summer in London with the officials of the British Marine Piling Committee. I cannot help but express my admiration for the manner in which the British engineering world has attacked this problem.

At the building of the Bridge Institution of Civil Engineers they had commodious quarters, including a large room which had been turned into a museum. It was amazing to see the collection of material that had been sent from all parts of the British Empire; not only had the material been sent, but what was even more remarkable, it had been very carefully taken care of with printed labels, classified with practically all of the detailed information obtained on each specimen readily accessible on a card catalog.

Dr. Crosthwaite, the Secretary of the British Committee, is most enthusiastic in offering every possible co-operation with the Committee of this Association and volunteered to keep us advised from time to time of any discoveries they might make.

They had two specimens of teredos sent to them from New Zealand. One measured three feet and a quarter of an inch in length and the big, or working end of the organism, the diameter inside of the shell, was a little over three inches. Imagine a creature a little over a yard in length, three inches wide.

I hope next year the committee may be able to publish a photograph of these teredos.

Referring strictly to the co-operative work to which we are indebted to the Southern Pacific railroad, you will remember that at the time of the San Francisco work, certain piers belonging to the Southern Pacific railroad showed remarkable immunity. The reason for this immunity was a remarkable mystery.

But due to the co-operation of the Southern Pacific, a number of these piles were transplanted, some in Seattle harbor in the northern Pacific, some in the piers of the Santa Fe in Southern California and certain pieces were submerged in the piers of the L. & N. railroad at Pensacola.

We have given sufficient interest in this to give a rather detailed record of the most recent examination of those piles. The possible striking fact is that practically most of them, even in these locations of high teredo attack are still comparatively free. Why that is or what the Southern Pacific did to these piles 20 years ago is still to be determined.

[The report on marine piling investigations was received as information without further discussion after which the remaining reports were presented and accepted

without discussion except for the report on Preservative Treatment of Trunking and Capping which was withdrawn because of slight differences in the specifications proposed by this committee and a committee of the Signal Section, A.R.A., which was acting jointly. The committee was excused with the thanks of the association.]

Report on Wooden Bridges and Trestles

Last year the Committee on Wooden Bridges and Trestles precipitated a controversy on the floor of the convention by submitting exhibits on the classification of lumber for inclusion in the Manual, which were interpreted by some as in the nature of a substitution for existing rules of lumber classification. In this year's report the committee presents a revised report on the subject which is declared "the most comprehensive specifications of lumber and timber heretofore compiled." The committee also presented information on the value of treated timber in wooden bridges and trestles, including a chart of the annual charges for upkeep. A. O. Ridgway has been chairman of the Committee on Wooden Bridges and Trestles for 4 years and has been a member since 1915.

A. O. Ridgway
Chairman

THIS committee's report took the form of four appendices. Appendix A comprised a brief statement concerning changes in the Manual, none being offered. Appendix B embraced a large amount of material relative to the "Simplification of Grading Rules and Classification of Timber and Lumber for Railway Uses." Appendix C contained a report on the Value of Treated Timber in Wooden Bridges and Trestles, while Appendix D constituted the result of a study of the classification of the uses of timber and lumber on the railroads and took the form of tables giving the recommended grades of lumber to be used in various parts of wooden bridges, buildings, tanks, fences, culverts, etc.

Appendices A and C were submitted as information, while Appendices B and D were offered for approval and inclusion in the Manual. Below is a brief abstract of Appendix B and an abstract of Appendix C.

Committee: Arthur Ridgway (D. & R. G. W.), chairman; J. B. Maddock (C. of Ga.), vice-chairman; H. Austill (M. & O.), O. C. Badger (A. T. & S. F.), Charles Chandler (I. C.), C. R. Chevalier (P. T.), C. M. Chumley (I. C.), F. H. Cramer (C. B. & Q.), W. J. Gooding (S. A. L.), E. M. Grime, (N. P.), W. E. Hawley (D. M. & N.), F. M. Hawthorne (Pa.), C. S. Heritage (K. C. S.), C. J. Hogue (West Coast Lumberman's Assn.), D. F. Holtman (Con. Engr.), W. H. Hoyt (D. M. & N.), T. F. Laist (Nat'l. Lumber Mfgrs. Assn.), J. R. C. Macredie (C. P.), J. A. Newlin (Forest Products Lab.), C. E. Paul (Armour's Inst. of Tech.), G. W. Rear (S. P.), D. W. Smith (H. V.), G. C. Tuthill (M. C.), J. T. Vitt (Wabash), S. L. Wonson (M. P.), S. R. Young (A & W. P.)

Appendix B—Classification of Timber for Railway Uses

The committee presented the major classifications as follows:

Use Classification

Lumber is classified as (a) yard lumber, (b) structural timbers, and (c) shop or factory lumber. Different grading rules apply to each class of lumber.

Yard lumber is lumber that is less than 6 in. in thickness and is intended for general building purposes. The grading of yard lumber is based upon the use of the entire piece.

Structural timber is lumber that is 6 in. or over in thickness and width. The grading of structural timbers is based upon the strength of the piece and the use of the entire piece.

Shop or factory lumber is lumber intended to be cut up for use in further manufacture. It is graded on the basis of the percentage of the area which will produce a limited number of cuttings of a given minimum size and quality.

Size Classification

Strips are yard lumber less than 2 in. thick and under 8 in. wide.

Boards are yard lumber less than 2 in. thick, 8 in. or over in width.

Dimension includes all yard lumber except boards, strips and timbers, that is, yard lumber 2 in. and under 6 in. thick, and of any width.

Planks are yard lumber 2 in. and under 4 in. thick and 8 in. and over wide.

Scantlings are yard lumber 2 in. and under 6 in. thick and under 8 in. wide.

Heavy joists are yard lumber 4 in. and under 6 in. thick and 8 in. or over wide.

Manufacturing Classification

Manufactured lumber is classified as rough, surfaced, and worked.

Rough lumber is undressed lumber as it comes from the saw.

Surfaced lumber is lumber that is dressed by running through a planer. It may be surfaced on one side (S1S), two sides (S2S), one edge (S1E), two edges (S2E), or a combination of sides and edges (S1S1E) (S2S1E) (S1S2E or (S4S).

Worked lumber is lumber which has been run through a matching machine, sticker or molder. Worked lumber may be matched, shiplapped or patterned.

Matched lumber is lumber that is edge dressed and shaped to make a close tongue and groove joint at the edges or ends when laid edge to edge or end to end.

Shiplapped lumber is lumber that is edge dressed to make a close rabbetted or lapped joint when laid edge to edge.

Patterned lumber is worked lumber that is shaped to a patterned or moulded form.

The committee then followed with a long list of definitions of timber defects and blemishes, the American lumber standards for softwood lumber and for structural grades, concluding with specifications for structural joists, planks, beams, stringers and posts and with tables of working stresses.

Appendix C—The Value of Treated Timber in Wooden Bridges and Trestles

Treated timber is used extensively for the construction of wooden railway bridges, especially trestles. Statistics show that the use of treated timber for this purpose is increasing. The value of treated timber in wooden bridges and trestles can best be determined by comparing it with untreated timber.

The primary consideration is whether or not the use of treated timber is economical. Other features to be considered are the strength and fire hazard as compared with untreated timbers, and the effect of the

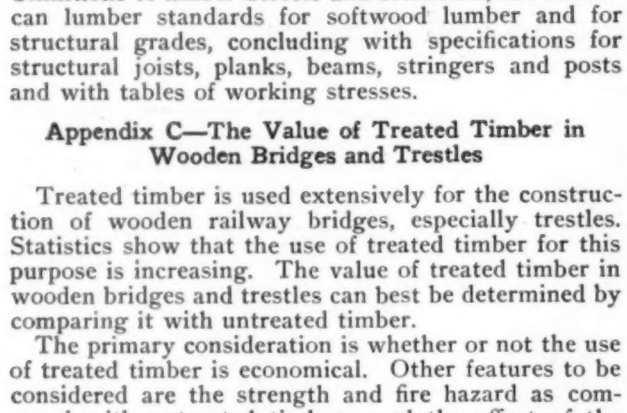

Annual Charges for Timber Trestles of Various Relative Costs
And for Various Periods of Life
Total Annual Charge Equals the Sum of the Following Items
(1) Interest Charges on Original Investment at 6%
(2) Sinking Fund Charges = $\frac{r}{(1+r)^n-1}$ Where r = Rate, Taken at .06
And n = Number of Years Life of the Structure.
(3) Maintenance Charges = ½ of Original Investment Spread Over
The Period of Life of the Structure.
Annual Charges for Various Amounts Expended
Life of Trestle in Years

Chart for Determining the Relative Economy of Structures of Various Relative Costs and Service Life

creosote on the fastenings. In special cases where timber is subject to ravages of the teredo, treated timber is satisfactory for use where untreated timber is entirely unsuited. Timber treated for use in railway bridges is usually creosoted and the treated timber considered in this report is timber treated by creosoting.

The relative economy of treated timber depends on the first cost, the life and annual maintenance charges of treated timber structures as compared with untreated timber structures. The cost of timber and of creosoting timber are both variable, but in general creosoted trestles will cost approximately one and one-half times as much as similar untreated structures.

The life of untreated timber in trestles will generally not exceed 10 years except in favorable climates. Sometimes trestles are kept in service much longer but at considerable maintenance expense for replacing decayed timbers.

Creosoted timber has not been generally used in railway bridges a sufficiently long time to determine its average life absolutely. Some structures have lasted 30 and 40 years and still retain a big per cent of the original timber. Others have been renewed after a service life of less than 20 years. Of the latter class the short life has usually been due to imperfect knowledge of handling, either in the treatment of the timber itself or by failing to protect the cut surfaces when framing the timbers. The art of creosoting timbers and of handling creosoted timbers has improved so that it is safe to predict a minimum useful life of 25 or more years for creosoted timbers in bridge structures.

As to maintenance costs on timber structures, this is variable and the practice of roads is different, some replacing bridges more frequently to avoid high maintenance charges after the structure has deteriorated, others carrying the structure with repairs and partial renewals for longer periods. In general, the committee believes that when the structure has deteriorated to the extent that one-half of the original cost has been used for maintenance the structure should be replaced.

Following is a diagram showing the annual charges for timber trestles for various periods of useful life. These charges are based on an interest charge of 6 per cent on the invested capital, a sinking fund for renewal at the end of the life of the structure, and a maintenance charge equal to one-half of the total cost of the structure spread over the life of the structure. The maintenance charges will naurally be small during the first years of the life of the structure and increase during the last years, but for a matter of comparison, it is assumed to be spread over the period of useful life uniformly.

Assuming the cost of an untreated structure as unity and of a similar creosoted structure as 1.5, the life of an untreated structure as 10 years and of creosoted structure as 25 years, then the annual charges for the untreated structure will be 0.186, as against 0.147 for the creosoted structure. This may be taken as a fair average condition, but for different relative costs and different periods of life comparisons can readily be made.

From observations on the life of creosoted structures we can safely predict a longer average life than the necessary minimum to produce annual charges as low as that for untreated structures. In other words, the committee believes that creosoted timber used for bridge structures will show a considerable saving over a period of years.

Creosoted ballasted deck structures are being built extensively by many roads. This type of structure is rarely built of untreated timber on account of its short life. The relative cost of untreated open deck structures and creosoted ballast deck structures is more variable than when trestles of similar design are considered because the variation of design must be considered as well as the variation of the cost of materials. Our estimates indicate that a creosoted ballasted deck trestle will cost from 1.8 to 1.9 times as much as an untreated open deck trestle for the same loading. The diagram can be used for comparing the economy in this case just as well as it is only necessary to determine the relative cost and relative life. Assuming the cost of the untreated structure as unity and with a 10-year life as before, then a creosoted ballasted deck trestle costing 1.8 times as much would have to have a life of 23½ years to be as economical as the untreated structure, and if the cost were double the minimum economical life would be a little less than 28 years. It is thought that such a structure will have a life in excess of the minimum required for economy and that such a structure will have the added advan-

tage of a better riding track, less maintenance and the fire hazard nearly eliminated.

The above discussion is based on the assumption that the cost for timber in place will be the same for each successive renewal. It is probable, however, on account of the increasing cost of timber and labor the cost of timber in place will increase to a considerable extent between renewals, so that the savings accomplished by the use of creosoted timber will be even greater than indicated.

The strength of creosoted timber as compared with untreated has been studied to a considerable extent, but the data obtainable are conflicting and unsatisfactory. In general, pine takes creosote oil quite readily and the strength is very little affected under modern processes of treatment. Fir is more difficult to treat, the timber being more highly resistant to the penetration of the oil. Under some processes the high temperatures used in boiling and the pressure used in treatment have lessened the strength from 15 to 40 per cent. However, the methods are improving and it is thought that the fir being treated at the present time has lost little if any of its original strengh. Tests are now under way which are expected to bear this out. With proper handling of the treating of timber the same working stresses can be used for creosoted timber structures as for untreated structures. The specifications for treatment and the quality of timber used must be considered in assigning working stresses.

The fire hazard of creosoted timber is less than for untreated after the creosoted timber has been exposed to the weather for six months to one year, so that the more volatile oils have evaporated. This is borne out by tests on the ignition point of treated and untreated timbers and by tests on the amount of treated and untreated timber consumed by fire under similar conditions as reported in the National Fire Prevention Association's Proceedings for 1915, also by the observation of numerous cases of fire in creosoted timber structures.

The treatment of timber is advisable by prolonging its life and by utilizing certain grades of timber that are satisfactory for use when treated, but which are entirely unsuitable in the untreated state. For instance, it is not necessary to restrict the sap content of timber that is to be treated, while untreated sap pine or fir decays so quickly that it cannot be used untreated.

The committee concludes that the construction of wooden railway bridges and trestles should be of treated timber, except when such construction is known to be temporary.

The use of creosoted timber will in general reduce the annual charges as compared with untreated timber.

If properly handled in the creosoting plants, the strength will not be materially reduced and the same working stresses can be used as for untreated timber.

The fire hazard is somewhat reduced, and if the treated structures are of the ballasted deck type, the fire hazard is practically eliminated.

Discussion

[The report was presented under the direction of Chairman Ridgeway with W. E. Hawley (D. M. & N.). Sub-Committee chairman, presenting the report in Appendix B, on simplification of grading rules and classification of timber and lumber, and it was moved *to accept the subject matter in Exhibit A, for inclusion in the Manual.*]

Dr. Herman von Schrenk (N. Y. C.): I want to second that motion and take great pleasure in doing so. I regard this as a very remarkable accomplishment. Last year the committee of this Association and the committee of the American Society for Testing Materials were at differences over this subject. I take particular pleasure in complimenting the committee this year on the manner in which they proceeded to correct the differences which existed between these organizations. At a meeting held here yesterday that committee of the American Society for Testing Materials, agreed to the report of the Committee on Wooden Bridges and Trestles, and they will present it to their Society in June.

A. F. Robinson (A. T. & S. F.): The committee is to be congratulated on its report and I hope the Association will follow its recommendation.

It is possible and probable that after we have used these rules for a year or two we may want to modify them slightly, but the two committees together have worked very well.

[*The motion to accept Exhibit A was carried following which Exhibit B was also accepted.*]

Chairman Ridgeway: I fear that this last section adopted has not been given careful consideration by the members. When you study it, you will observe that the recommended working stresses are quite different from those that now appear in the Manual. They are increased in some cases, but that has been done because of the fact that with the work J. A. Newlin has done at the Forest Products Laboratory, we know a great deal more about the behavior of wood under stress than we formerly knew. For example, we used to say for stringers we would accept a factor of safety of five in ultimate breaking stress. We did that because we didn't know the influence of the defects in the timber on its available strength. Mr. Newlin in the Forest Products Laboratory at Wisconsin has rendered a service, I think, to the railroads of this country that has been unequaled in the use of timber. He has undertaken and has proved the disastrous effect of the defects of timber on its strength. I am sure that it would profit every member of this organization to obtain from the Forest Products Laboratory something of the work they have done along this line.

Meyer Hirschthal (D. L. & W.): I didn't quite understand that this whole section was to be passed. I wanted to make a comment on the paragraph reading "In moving loads, as on highway bridges or railway stringers, in computing the shear at one end it is safe to ignore all wheel loads between this support and a point three times the depth of the beam."

I believe that is too drastic a change for 8-in. by 16-in. stringers, which are very often used for wooden trestles for railroad loadings. You would have a point four feet away which would be where all loads would be borne between that point and the support. I think that is going too far. Very often those 8-in. by 16-in. stringers are used on spans no longer than 10 or 12 ft. That would bring that point very near to the center of the span.

Chairman Ridgway: I don't believe we have the time to enter into the technical discussion of this particular phase. You have been advised heretofore that we have found in the case of horizontal shear that we might have to revise our ideas and the ordinary methods of computation of the maximum shear under concentrated or moving loads.

[W. H. Hoyt (D. M. & N.), as sub-committee chairman on the study of the classification of the uses of timber under the A. R. E. A. specifications, presented the report as contained in Appendix D; which was

adopted, whereupon a progress report on the volume of treated timber was presented by C. S. Heritage (K. C. S.).]

A. F. Robinson (A. T. & S. F.): The committee in discussing or in reporting heretofore on creosoted timber noted that they didn't have any definite information regarding certain features. I would call attention to the fact that on Southern pine, quite a good many years ago, the Santa Fe ran a series of very careful tests. The first portion of the stringers was tested within a month after treatment. The stringers were full cell treated without temperature process and shipped to Topeka immediately and tested. The control pieces, untreated, were stored. About a year after this series, the other half of the pieces was treated in the same manner. We found that when the new timber was tested right after treatment, there was a small loss in ultimate bending strength. We also found that after a year of storage, this was all regained and the creosoted timber was actually stronger than the untreated control pieces which had been stored in the yard for final seasoning. This whole information appeared in a bulletin of this Association and it can be found in the transactions.

H. C. Crowell (Penna.): Concerning the statement in Exhibit D that, "In general the committee believes that when the structure has deteriorated to the extent that one-half of the original cost has been used for maintenance that the structure should be replaced." I can see a connection between the cost of heavy repairs and the cost of replacement, but I don't see the connection between the accumulative cost of repairs in the years that have gone and the present cost of replacement. It seems to me this is a new theory and the Chairman might explain the basis of it.

I want to make sure that the grounds for the statement are good before it gets into the Manual which may be next year. It seems to me this kind of a rule is a pretty dangerous thing to be put into our reports.

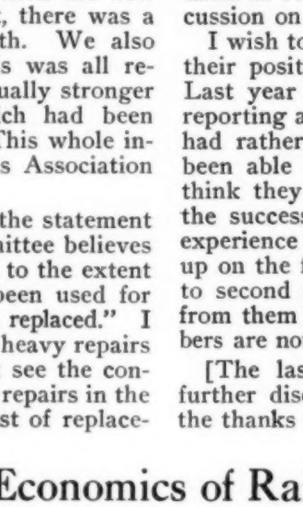
President Fairbairn: I think the remarks are well taken, and the committee is submitting the report only as information at the present time in the whole. I wish to impress that again on the convention. These reports that are submitted as information are to come up again the following year, and it is hoped by the Board of Direction and by the Committees in each case that the members of the Association will assist them in every way possible by sending in written discussion on what is submitted as information.

I wish to say in connection with this committee that their position seems to me to be somewhat unique. Last year I was present when this Committee was reporting and, as Dr. von Schrenk has suggested, they had rather a rough passage. Apparently they have been able to pour oil on the troubled water, and I think they are to be most heartily congratulated on the success of their work when today they had the experience of two members of the Association getting up on the floor and congratulating them and wanting to second one of their motions without any request from them in any shape or form, and those two members are not members of the committee.

[The last subject having been received without further discussion, the Committee was excused with the thanks of the Association.]

Report on Economics of Railway Labor

The cost of instability of employment, the profit in organized motor car upkeep and the spectre of idle work equipment, are three subjects, the timeliness of which is second only to their present importance. The report provides substantial data applicable to these problems. This includes views of business houses on the advantages of the more uniform use of materials, also descriptions of how seven different roads are now providing for motor car upkeep, together with itemized tables of comparative costs for operation and repair, while the report also reviews the advantages of various work equipment and tabulates new information on the savings afforded in specific undertakings. C. C. Cook has been chairman of this committee for 3 years and a member for the last 6 years.



C. C. Cook
Chairman

THE committee presented reports covering the following subjects:

(2) Standard methods for performing maintenance of way work and establishment of units of measure of work performed (Appendix A). (3) Extent to which it is practicable to stabilize employment in the maintenance of way department in the interest of efficiency, and the necessary measures (Appendix B). (4) Methods of maintaining motor cars (Appendix C). (5) Economy in use of labor-saving devices (Appendix D). (6) Educating and training maintenance of way employees (Appendix E).

It recommended: 2. That the conclusions in Appendix A, relating to the discontinuance of the subject of standard methods for performing maintenance of way work and the establishment of units of measure of work performed, be approved and accepted as information. 3. That the report in Appendix B, on the extent to which it is practicable to stabilize employment in the maintenance of way department in the interest of efficiency and the necessary measures thereto, be accepted as a progress report. 4. That the conclusions in Appendix C, relating to methods of maintaining motor cars, be approved for publication in the Manual. 5. That con-

clusion (1) in Appendix D, relating to the economy in use of labor-saving devices, be approved for publication in the manual.

That conclusions (2) and (3) in Appendix D, relating to the same subject, be accepted as information.

6. That the report in Appendix E, relating to educating and training maintenance of way employees, be accepted as information.

Committee: C. C. Cook (B. & O.), chairman; A. N. Reece (K. C. S.), vicechairman; Lem Adams (U. P.), M. C. Blanchard (A. T. & S. F.), A. S. Butterworth (M. S. B. & P.), H. A. Cassil (P. M.), G. C. B. Dunn (C. N. R.), John Evans (M. C.), J. A. Heaman (G. T. W.), E. B. Hillegass (A. C. L.), E. T. Howson (Ry. Age), P. B. Jeffries (A. & V.), and V. S. & P.), F. G. Jonah (St. L.-S.F.), C. E. Johnston (K. C. S.), J. D. Keiley (C. & O.), J. W. Kern, Jr., (I. C.), J. B. Mabile (C. R. I. & P.), A. C. Mackenzie (C. P. R.), W. A. Murray (N. Y. C.), G. M. O'Rourke (I. C.), R. L. Pearson (N. Y. N. H. & H.), W. L. Rohbock (W. & L. E.), R. W. Ross (C. N. R.), R. L. Schmid (N. C. & St. L.), F. S. Schwinn (I.-G. N.), J. M. Sills (St. L.-S. F.), F. M. Thomson (M.-K.-T.), Cale Wamsley (M. P.), C. E. Weaver (C. of Ga.), B. A. Wood (M. & O.).

Appendix A—Standard Methods for Performing Maintenance of Way Work and the Establishment of Units of Measure of Work Performed

The committee reviewed its previous work on this subject. This year the committee made further studies, considering the maintenance of way accounts and charges in an effort to determine whether the maintenance expenses could be expressed in a form of some unit per mile of line, or in some uniform traffic unit which would be representative of a fair and normal allowance for ordinary maintenance purposes and for the several classes of railroads in the different sections of the country.

A questionnaire was circulated among carriers which called for a reporting of mileage and other necessary physical data required for the purpose of ascertaining the amount of property maintained and also other statistical data covering speed of trains, freight car and passenger car mileage, as well as the maintenance of way charges by accounts for the years 1923 and 1924. Forty-one carriers, representing 120,205 miles of operated line, fairly well scattered throughout the country, furnished replies to this questionnaire. From the physical data attached to the replies the different lines have been equated to an equated main line mileage, using as a basis the equivalents shown in the Proceedings of 1922 and again published in the 1925 Proceedings.

The railways reporting were also classified in accordance with the Classification of Railways, as published in the 1921 Manual

The maintenance charges were tabulated by accounts and classes of railroads under the several different regions, and studies and comparisons of this tabulation were made. These comparisons indicated a somewhat higher cost of maintenance per equated mile of Class "A" roads as compared with Class "B" roads, but the difference is not uniform. In general, the cost per thousand car miles of line was greater on Class "B" roads than on Class "A" roads. The differences, however, do not follow any fixed rule; they are so variable that it is not possible to develop a uniform relationship.

A further study was made of the charges which are in part or in whole affected by use. While in general the charges under accounts affected by use are greater per equated mile on Class "A" roads than they are on Class "B" roads, and the charges per thousand car miles per mile of line are usually found to be greater on Class "B" roads than on Class "A" roads, no fixed relationship could be determined and no rule could be developed whereby such charges could be forecast. Further examination was made of the charges under Account 212, Ties. While this account is heavily affected by use, the comparisons indicate no fixed ratio as between the different classes of railroads and the charges appear to vary considerably in the different regions, this being undoubtedly due to the differences in climatic conditions and kinds of ties used.

Conclusions

It is the conclusion of the committee that it is not possible to determine a fixed unit of cost of maintenance of way and structures accounts for any unit of property, such as the equated mile, or for any unit of use, such as thousand car miles. It is further the conclusion that it will be impossible to determine upon such unit of cost at any future time unless all railroads were to adopt the use of standard materials and standard practices, and even then there would exist differences reflecting the differences in location, climatic conditions and physical construction.

The committee felt that it has exhausted this study as far as it is possible to do so at the present time, and it again recommended that it be relieved from further study of this subject.

Appendix B—Extent to Which it is Practicable to Stabilize Employment in the Maintenance of Way Department in the Interest of Efficiency, and the Necessary Measures

The committee felt that this subject should be divided into three separate and distinct sub-divisions:

First—The equalization of expenses.

Second—The determination of the extent to which the maintenance of uniform forces is justified, and

Third—The effect of uniform purchases of materials on their cost.

The committee, in its report for last year, covered very fully the advantages of the equalization of expenses. However it deemed it advisable to obtain data on the working of equalization. Therefore, it sent out a questionnaire to fifty representative railroads, embodying all classes of lines and territory in the United States. Out of these fifty questionnaires, replies were received from thirty-four.

Eighteen of these roads are using equalization in some form. Fifteen railroads do not resort to equalization at all and have never done so. One railroad equalized for two years (1922-1923), then discontinued the plan for two years, and now advises that it will return to the equalization of several of the Primary Accounts in 1926. It is particularly gratifying to learn that not one railroad, having taking advantage of the I. C. C. order permitting of the equalization of expenses, has condemned the practice or found it in any way unworkable, but, on the other hand, they give the plan the highest endorsement. One large Eastern system took up equalization in 1925, due to the scope and simplicity of accounting afforded in the new General Account No. 280.

Only one railroad, so far reported, equalizes for all accounts. One equalizes for ties only; seven equalize for ties and rail only; three for ties, rail and ballast; one for ties, rail and other track material; three for ties, rail, ballast and other track material, and two for ties, new rail, other track material, for new rail, and labor applying new rail. (One of the latter railroads will extend the plan to ballast in 1926) Sixteen of the eighteen railroads using the equalization plan make their spread over the entire twelve months period, and two railroads make the spread over nine months only.

The railroads using the equalization plan are largely doing their major work in months best suited therefor.

Out of the 13 railroads reported as not resorting to equalization, six appear to favor the plan, but for various reasons do not use it, and two of these hope to get it authorized in 1926. Six advise that they do not think the equalization plan of any advantage.

From these reports there appears to be a strong majority of railroads favoring the adoption of the equalization of expenses for the two, three or four major primary accounts for maintenance of way work. The prevailing reason for such action is the advantages afforded by, and the evident economy from, doing work seasonally, and in most instances at a time of the year when traffic is light, thus causing the minimum interruption thereto and having a minimum delay to their work therefrom. It also prevents the distortion of operating ratios and spreads the expense over the entire year for doing renewal work, which appears to be the correct condition, since the forces destructive to track are at work throughout the year.

From the experience of the railroads that are practicing the equalization of expenses, it does not appear that there are any material disadvantages to offset the numerous advantages. Therefore, your committee wishes to endorse the practice as economically sound, and recommends its general adoption on our railroads, as we feel that by its application a more uniform force may be engaged in maintenance of way work and distributed over a greater portion of the year, thereby tending toward the stabilization of forces.

The committee had nothing to report on sub-division No. 2, but is assembling information in connection therewith and proposes continuation of the study next year.

SUB-DIVISION NO. 3—THE EFFECT OF STABILIZATION OF MATERIALS AND OF THEIR COSTS

The cost of maintenance of way work is divided between two major factors, labor and material. The effect of stabilization of forces is reflected largely and most directly in the labor costs. However, since the rate of use of materials varies with the number of men employed, any measure which tends to promote uniformity of employment will at the same time lead to the more uniform use of materials, and this in turn will tend to the more uniform distribution of their purchase and delivery throughout the year. To ascertain whether this will be reflected in the cost of these products, the committee made inquiry of leading companies in widely separated branches of the engineering and maintenance of way supply field, inquiring specifically as to the following points:

1. To what extent is your business and that of your section of the railway supply industry seasonal? In other words, does your business tax your facilities seriously at times, and leave them only partially utilized at others? At what periods of the year is your production at the maximum and the minimum?
2. To what extent do you regard this fluctuation as necessary and to what extent due to a "hand-to-mouth" policy of purchasing by the roads?
3. In the operation of your plants, are you able to use dull periods to accumulate stocks for later orders, or is it necessary to curtail operations and reduce forces? What is the effect of such curtailment on your production costs when your business again picks up?
4. To what extent would uniformity of purchasing aid you in reducing your cost of production?
5. Would you consider it practical to delay billing the roads for all or a portion of their orders taken into stock if the desire to avoid the accumulation of large stocks by the roads is a detriment to uniform buying?
6. In brief, do you believe that more uniform buying by the roads will be reflected in savings in the cost of their material?

Abstracts from these replies accompanied the report. A study of them leads to the inevitable conclusion, which is in accord with experience elsewhere in industry, that minimum cost is secured through uniform production. Competition is such that reductions in manufacturing costs are reflected ultimately if not directly in prices charged the railways. Stabilization of forces, with the resulting increase in the uniformity of use of materials, should therefore lead to savings in the cost of these materials over and above the savings effected directly through the increased efficiency of the forces. These savings are estimated by some manufacturers to be as high as 10 per cent of their present cost of production.

Appendix C—Methods of Maintaining Motor Cars

The railroads have adopted the motor car as an economical means of transporting labor and material. The adoption by the railroads has been so rapid and general that they now have a large investment in motor car equipment; and yet investigation shows, with a few exceptions, a lack of organized maintenance methods to insure a maximum reliability in service and minimum cost of maintenance and operation.

Since about 1910 there has been a big increase in the use of motor cars on railroads by the various classes of maintenance of way and other employees in handling their work. This has been accomplished in rapid strides by improved types of motor cars to best meet the many requirements of the railroads and at the same time decrease the expense. The recognition and adoption of the motor car has been so quick and so general that the railroads now have millions of dollars invested and yet many have not fully developed an efficiently organized method or system of maintenance. A study of the systems of motor car maintenance on the railroads by this committee shows many varied types of organizations with a lack of accurate data in the majority of instances being kept as to actual cost of maintenance and operation of the various makes and types of motor cars; also their records often fail to show the percentage of cars which are out of service in the shops and the percentage of cars on assignments out of service awaiting repairs in the field.

In order to get the maximum results from the investment it is apparent that motor cars should be maintained in serviceable condition on a regular assignment. Cars out of service while assigned not only result in loss of interest on the investment, but also in additional expense through the slowing up of the handling of men and material. Since the general adoption and use of motor cars, new methods of handling work on a more efficient and expedient basis have been developed. As a consequence, when a motor car fails, the job is interfered with more seriously than had the work been planned for the use of the less expedient handcar.

The committee selected thirty of the principal railroads of the United States and Canada and investigated with them as to their methods of motor car maintenance. The methods in use by them were found to be varied from meager organizations for motor car maintenance to highly organized systems of keeping motor cars in first-class service condition at all times.

The committee felt that on the various railroads the conditions are such that no definite or fixed organization can be recommended to fit every railroad, particularly the smaller railroads or those having a limited number of motor cars to maintain. However, it felt that certain definite recommendations can be made towards the establishment of an organized system of motor car maintenance which will obtain reliable service from motor cars at an economical cost. The fundamental principles of this organization, if not all details, may also be ap-

plied with advantage by the railroads having a limited number of cars to maintain.

Fundamentals of Good Maintenance of Motor Cars

Any system organization for efficient and economical motor car maintenance should recognize the importance of the following:

1. Sufficient instruction to operators, with rigid enforcement.
2. Regular inspection and cleanliness as a preventative of failures.
3. Rapid and careful distribution of material and supplies.
4. Value of doing as much field repair work as possible to reduce delays to work.
5. A centrally located repair shop exclusively for motor cars, well equipped with modern machinery.
6. Supervisor of Motor Car Maintenance and Operation with authority.
7. Desirability of uniform records of costs.
8. Simplification and standardization of types and parts.

It depends somewhat on individual opinion which one of the above items is most important. Under importance attached to one without due regard to the others would easily defeat the success and efficiency of the whole plan.

Conclusions

The varying conditions on different railroads do not permit the universal acceptance, in all details, of any specific outline of an organization for the maintenance of motor cars, especially on those railroads which use only a limited number of cars. However, certain fundamental principles can be recommended for the establishment of an organized system which will obtain reliable service at an economical cost. The following principles, while essential to roads having a large number of motor cars, also apply in some degree to all railroads, depending upon the number of motor cars in service.

1. The instructions for motor car operators should be plain and sufficient, and should be rigidly enforced. Rules relating to the care and operation of motor cars, included in the "Rules for the Guidance of Employees of Maintenance of Way Department" in the Manual will serve as a guide in formulating these instructions.

2. Motor cars must be kept clean, and must be inspected regularly by the operators. Clean cars give longer service, with less trouble, and cost less for maintenance. Clean cars indicate that inspections are being made regularly by the operator. This will aid in detecting defects before they become serious.

3. Stores should be centrally located, for rapid distribution of repair parts, in order to get cars back into service with the least delay. Requisitions should be judiciously checked. The use of relief cars and relief power units will reduce delay in the event of motor car failure.

4. The emphasizing of field repairs while on the job, and the sending of cars to shops for overhauling on a schedule regulated in accordance with the current output of the shop, not based upon the service and mileage that should be reasonably expected from the car, will insure maximum service from cars.

5. Where there is sufficient work to justify, motor car shops centrally located and wholly under the control of the maintenance of way department, should be maintained for repairing worn or damaged cars. Modern equipment, especially designed to meet the requirements of motor car repairs, should be provided.

6. The organization for the maintenance of motor cars should be headed by a practical railroad man, with sufficient executive ability and sound mechanical knowledge to supervise the maintenance and operation of motor cars over the entire system. To be most successful this system supervisor should have authority to institute certain regulations for the care and operation of motor cars, and to enforce them. The success and value of motor cars depend just as much on the methods of maintenance and operation as upon the cars themselves. The system supervisor's duties should embrace direct control of all mechanical details of the cars, supervision of all maintainers, responsibility for correct individual and system reports, regulation of purchase of cars and supplies in conjunction with the Stores Department, and supervision through other officers of the care and operation of motor cars.

Motor Car Maintainers, approximating one for each 100 cars, should report to the System Supervisor, or, through the divisional organization, be responsible to him. They should spend their time on the road instructing operators and making regular field inspections and repairs.

7. Uniform records of inspection, and of cost of maintenance and operation are indispensable in determining the most economical type and make of motor car. Such records will indicate whether an organization is operating efficiently, and will furnish a basis for comparison. These records will also indicate the expense justifiable in keeping a car in condition for service. In keeping these records the forms presented in Exhibits 1, 2, 3 and 4 are recommended.

8. Motor car maintenance expense can be reduced through the adoption of the fewest number of makes and types of cars by each railroad to best meet its needs and requirements. The use of standard parts interchangeable with various makes of cars is recommended to reduce investment in stock parts and to lower maintenance costs.

Appendix D—Economy in Use of Labor-Saving Devices

In order to overcome the effect of limited force, inefficient, and, in most cases, inexperienced labor, labor-saving devices have become a necessity. Special study and experiment have resulted in the adoption of numerous devices in an attempt to reduce this labor cost and increase output per man, with the result that at this time machines are being developed to assist in the performance of almost all maintenance operations. With the use of such machines, in numerous cases comes their acceptance as labor savers without any knowledge of the actual saving realized, and possibly in some instances of whether any man hours are actually saved.

Realizing the scope of the field of study, the committee decided to concentrate its efforts on a limited number of devices and to make a thorough investigation of a few rather than to touch lightly on a large number and arrive at no definite conclusions. Consequently, the following seven devices were selected for consideration in this report:

Motor Cars.
Weed Destroyers.
Rail Cutting, Drilling and Building Up Devices.
Tie Tamping Machines.
Rail Layers.
Ditchers.
Locomotive Cranes.

With the adoption of labor-saving devices comes the necessity of a special force to attend strictly to their maintenance. In order to prevent valuable equipment from lying idle because of some minor difficulty, and to prevent interruptions to the carefully planned programs, it is to the best advantage of the railroad companies to retain skilled mechanics to make needed repairs and adjustments at the time of break-downs and to have on hand essential repair parts and extra equipment.

Inspections at regular intervals by these mechanics

have eliminated much of the delay due to improper working of the machines. At the end of the working season, all machines should be sent to the shops where they should be given a careful examination, thoroughly overhauled and placed in readiness for full service during the following season.

The work of this committee was carried on with the view of studying in detail the operation of each device and of comparing the relative values of the different types for performing the same work to each other, as well as studying the actual saving realized by each machine compared to doing the work by hand.

In some instances it is difficult to make a direct comparison of devices intended to perform similar operations due to the vastly different operating conditions, and to the scarcity of data. In the compilation of this report data have been accumulated from railroads in the United States, Canada and Mexico, and from the reports submitted it is apparent that the study of the economy resulting from operation of labor-saving devices is in its infancy.

It was at first thought advisable to restrict the source of information to data obtained from "Class 1" roads entirely, but after further consideration it was decided to draw information from as many railroads as possible, believing that in many instances smaller railroads having more limited capital, feel a more urgent need of labor-saving devices in order to provide properly maintained track.

Conclusions

1. The economy derived through the use of the labor saving devices subjected to investigation during the year 1925, viz., motor cars, weed killers, rail cutting and building up devices, tie tampers, rail layers, ditchers and locomotive cranes has been demonstrated and their use is recommended.

2. In order to arrive at the actual savings realized, additional study is necessary because the subject is of such magnitude that it is practically impossible to cover more than a small portion of it in one report. It is the recommendation of the committee that investigations along these lines be continued, a small number of labor-saving devices being selected for detailed study each year.

3. A large amount of the data from which this report was compiled was incomplete and showed a marked need of an accurate method by which cost data on labor items should be recorded. As assistance in future work along these lines, this committee recommends that the committee on Records and Accounts be requested to prepare a set of standard forms on which data relative to labor-saving devices may be kept. The adoption of forms of this nature will keep the desired information readily accessible, it will be in such form that it may be more accurately compiled and studied, and the information will be in the same units.

Appendix E—Educating and Training Maintenance of Way Employees

The committee reviewed the report it submitted in 1922 on this subject discussing its conclusions in the light of developments that have occurred since that report was submitted and paying especial attention to the discussion as to training and educating employees (other than engineers) in the maintenance of way department, citing the associations for the discussion of maintenance problems, the encouragement of study by the employees, including their affiliation with correspondence schools and the reading of periodicals devoted to maintenance matters.

Summary

It is the belief of the committee that much progress has been made in the last few years in all the features embraced by the ten conclusions based on the 1922 Report of this committee and that at the present time no modification of these conclusions is advisable .The committee realized that while many roads have shown a wholesomely progressive attitude in the activities herein discussed, there is much yet to be done by even the leaders in these movements, while there are many roads who have yet to undertake organized and concerted work of this variety. However, in the light of what has been accomplished in interest, the stabilization of working forces and economy by those who have engaged in these endeavors, the committee believed that increasing importance will attach to all movements tending to raise morale and cement goodwill between management and employee.

Discussion

[The report was the first of the afternoon session which was convened by Past President Hunter McDonald (N. C. & St. L.). The report was presented under the direction of Chairman Cook, the work of the sub-committee on establishing units of measure of work performed, in Appendix A, and that in Appendix B on stabilizing employment being accepted as information without discussion except for brief introductory remarks by the respective sub-chairmen. The report on maintaining water cars was then presented by the sub-chairman, F. M. Thomson (M. K. T), whose introductory remarks were in large part an extended re-reading of the printed report on this subject.]

T. E. Bliss (St. L.-S. F.): Is it the intent (referring to the principles set out in the report) that the system supervisor shall have charge of all the maintainers on the large systems, or that he shall have assistants in the way of division supervisors and that they shall report to him direct?

Mr. Thomson: The intention is that he shall have direct supervision over the maintainers. If the railroad is sufficiently large to justify it, I presume there will be assistant supervisors.

Mr. Bliss: It seems to me that the mainteaance officers in charge of the division should be responsible for the maintenance of their divisions. The head of this work on each respective division can be responsible to the system supervisor of motor cars for that particular work.

Mr. Thomson: It was the opinion of the committee that the supervision through other officers of the care and the operation of motor cars would mean that so far as the care and the operation of the cars were concerned, the maintainer would report directly to the division officers and through them to the motor car supervisor, but so far as the mechanical details and practices in repairs were concerned, they would report directly to the motor car supervisor or through his representatives.

W. C. Barrett: I suggest that that paragraph be omitted from this report until such time as the details of the organization can be worked out with the Committee on Rules and Organization.

I had some conversation with Mr. Cook, chairman of this committee, with reference to this report and it was our understanding that we would elaborate next year on this last paragraph.

Chairman Cook: This latter half of paragraph six is not a rule nor does it specify how they shall conduct the work. It is a general principle of organization that we attempted to state there, and it was determined after very careful consideration. I don't believe it would enter into

the work that we propose next year on rules. If it is left out, I am afraid it will be permanently left out.

Mr. Barrett: I move that the last paragraph of conclusion 6 be omitted.

The motion was regularly seconded and carried subsequent to which the other conclusions were adopted as revised by the committee.

[The report in Appendix D, Use of Labor Saving Devices, was then presented and adopted for inclusion in the Manual without discussion, following which the report in Appendix E—Educating and Training Maintenance of Way Employees was presented by the sub-committee chairman, A. N. Reece (K. C. S.), whose remarks are reproduced in part as follows.]

On the Kansas City Southern (referring to the committee's summary), we have made use of association meetings. These association meetings are held once each month and are primarily for the purpose of bringing together the section foremen, the road masters, the engineers, and the safety supervisors, and in addition to our local forces, we quite frequently have other speakers. For instance, our next meeting will be Saturday of this week when we have arranged for Dr. von Schrenk to be present with slides, to give a talk on "The Use of Treated Timber."

In addition to our association, the Kansas City Southern has encouraged the young engineers to complete their courses in universities, and has found service for them at the completion of their school years, and has encouraged a great many in going to the universities who have not had that opportunity before joining the service of the railroad. In that way we feel that we have co-operated to some extent with the colleges in that we are brought in closer touch with those particular schools in which some of our employees are attending.

We have still another plan that has worked very well, and that is the rotation in service. We give young engineers a chance to serve as road masters or in various other capacities in the maintenance of way forces that we believe broadens them and makes them better employees, fitting them for further promotion.

J. L. Jamieson (C. P. R.): Have you any practice by which you endeavor to introduce men with even a fair grade of common school education into the common forces so that you have the material there to draw from?

Mr. Reece: We have a personnel department and it is our policy to promote almost entirely from the ranks of labor to secure section foremen. Occasionally we hire section foremen from the outside. In that instance, they are required to pass a physical examination, and also are required to fill out a questionnaire; their records and previous educational training are investigated before they are employed.

[The report on education was received as information and the committee excused with the thanks of the Association.]

Report of the Committee on Buildings

The principal report of the Committee on Buildings is the culmination of several years of work given to such revisions of standing recommendations for the design of various railway buildings as will render the Manual a reliable reference source for detailed information on the best practice in undertaking present day work. The revised recommendations cover inbound and outbound freight houses, oil houses and passenger stations, while extensive revisions are submitted concerning the selection and application of roofing, of floor construction and on paint. Specifications for the purchase and application of various materials are also presented, as well as specifications for concrete. W. T. Dorrance has been chairman of the Committee on Buildings for 6 years and a member for 11 years.

W. T. Dorrance
Chairman

THE committee presented reports covering the following subjects:

(1) Revision of the Manual—The committee reports its recommendation in Appendix A. (2) Freight House Design—No work has been done on this subject during the past year. The committee felt that the reports previously presented by this committee and also by the Committee on Yards and Terminals have brought the subject up to date so far as information now available is concerned. (3) Specifications for buildings for Railway Purposes—The committee has prepared additional roofing specifications as indicated in "Appendix B," covering asphalt impregnated asbestos felt and asphalt cement.

The committee recommends for approval by the convention, for printing in the Manual, the specifications on roofing, presented to the Convention in March, 1925, and the additional roofing specifications presented in "Appendix B," and the specifications for concrete as printed in Appendix "A." (4) Ventilation of Railway Buildings, Except Enginehouses—No new data has been available since the committee's report of last year, and it is felt that this subject is in sufficient detail with the data at hand. The matter has been presented as information and there will be no recommendation for insertion in the Manual. (5) Ornamental Roof Covering for Passenger Stations—The committee considers this subject is covered in the Specifications for Buildings for Railway Purposes.

(6) Study and Report on the Design and Construction of Water Station Buildings, collaborating with Committee on Water Service—The committee conferred with the Committee on Water Service and believes that details of building construction should not be included in the report at this time. They are in accord with the general requirements as set forth,

with the omission of the building details.

It recommended:

1. The adoption of recommendations contained in Appendix "A." 2. That specifications for Railway Buildings covering the following subjects be approved for publication in the Manual: Concrete—Roofing.

Committee: W. T. Dorrance (N. Y. N. H. & H.), chairman; J. W. Orrock (C. P. R.), vice-chairman; G. A. Belden (C. of Ga.), Eli Christiansen (C. R. I. & P.), H. G. Dalton (C. B. & Q.), F. M. Davison (C. N.), C. G. Delo (C. G. W.), Hugo Filippi, (W. H. Brown & Co.), A. M. Griffin (A. C. L.), E. A. Harrison (A. T. & S. F.), A. C. Irwin (Portland Cem. Ass'n.), F. R. Judd (I. C.), L. L. Kelly (N. & W.), A. MacGlashan (N. Y. C.), D. F. McLaughlin (I. C.), Milburn Moore (Verona Tool Works), L. G. Morphy (Rutland), F. L. Riley (B. & O.), G. A. Rodman (N. Y. N. H. & H.), A. L. Sparks (M.-K.-T.), O. G. Wilbur (B. & O.), A. H. Williamson (F. E. C.).

Appendix A—Revision of Manual

The committee reviewed its work on this subject and stated that the present subject matter in the Manual relating to locomotive coaling stations is obsolete and should be disregarded. The committee on Shops and Locomotive Terminals is now studying the subject and its report, when adopted will replace the section now in the Manual.

The committee prepared and submitted for adoption specifications for concrete to be incorporated with specifications for buildings for railway purposes. With some revision of arrangement and diction these specifications are in close agreement with the specifications for concrete now in the Manual under Masonry, insofar as they apply to building construction, with the exception that the proportions for footings, piers, walls, etc., except those to be waterproofed or reinforced shall be in the proportion of 1 part Portland cement to 2½ parts fine aggregate and 5 parts coarse aggregate unless otherwise shown in the plans.

Specifications were added for concrete floors on fill, concrete base for wood floors, concrete floors on wood joists and concrete wall base as follows:

Concrete Floors—Concrete floors on fill shall consist of a base of thickness indicated on drawings composed of 1 part Portland cement and 2½ parts fine aggregate and 5 parts of coarse aggregate of the size as specified for reinforced concrete.

A finish one inch thick, composed of 1 part cement, 2 parts fine aggregate, and a metallic hardener, shall be applied in accordance with the manufacturer's specifications, before the base has set. This finish shall be floated and troweled to a smooth, hard and even surface, finishing neatly against walls. All floors shall be sloped to drains and finished neatly with same.

Concrete Base for Wood Floors—The concrete base for wood floors shall be of thickness indicated on drawings and shall be of the mixture specified above for base for concrete floors.

The filling between floor sleepers or screeds shall be concrete composed of 1 part cement, 4 parts fine aggregate and 8 parts coarse aggregate.

Stairs and Ramps—The surface of landings and treads of all concrete stairs and the surfaces of all ramps shall be finished with No. 30 Carborundum or "Crystalon" grains, using not less than one pound of grain to each square foot of surface, as follows: After the granolithic finish has been placed to within ¼ in. of the finished surface, float and work to a thickness of about ¼ in., a dryer mixture of 2 parts of cement, ¾ part trap rock screenings, ¼ part gravel and 1 part of grains. After allowing to set a little, sprinkle and float in clear grains until entire surface is thoroughly coated and impregnated with the grains.

Concrete Floors on Wood Joists—Concrete floors on wood joists shall be constructed according to details as shown on the drawings. The joists shall be beveled as shown with 1 in. by 6 in. D&M board filler placed between. Concrete of mixture specified above for concrete floors shall be placed and reinforced as called for on the plans. All such floors shall be finished as specified in paragraph No. 20.

Concrete Wall Base—Concrete wall bases for rooms shall be made from a mixture of cement, fine aggregate, and a metallic hardener, finished as specified for cement floors. This base shall be of the contour and height as detailed, and on stud construction shall be reinforced as shown and securely fastened to wall construction by means of metal anchors.

Appendix B—Specifications for Roofing

ASPHALT IMPREGNATED ASBESTOS FELT AND ASPHALT CEMENT OVER WOOD

TYPE "C1" (CLASS A)

Roofing composed of one layer approximately 60-lb., two layers approximately 14-lb., asphalt impregnated asbestos felt (the latter lapped 17 in.), and a minimum of 85-lb. asphalt roofing cement, per 108 sq. ft.

1. Lay sheets of asphalt impregnated asbestos felt weighing approximately 60-lb. per 108 sq. ft. directly over the sheathing. Lap the joints 3 in. and seal them with asphalt cement. Nail these sheets along the lap with barbed nails driven through flat tin caps, spaced 6 in. apart, and in parallel lines approximately 10 in. apart and approximately 10 in. from the laps, these nails to be spaced 18 in. apart and staggered. This 60-lb. felt shall be laid parallel to pitch of roof and turned up 5 inches above level of roof on all vertical surfaces, but not cemented to vertical surfaces.

Over the 60-lb. felt, edging strips composed of the flashing material shall be applied at eaves and gable overhang, extending 4 inches on roof, cemented and nailed, and turned down over and secured to facia and projected ½ inch beyond to form a drip edge.

2. Mop the entire surface of the 60-lb. felt with the asphalt cement, heated to flow freely, and while the cement is hot, imbed in it sheets of asphalt impregnated asbestos felt, weighing approximately 14-lb. per 108 sq. ft., in two-ply construction; this 14-lb. felt to be run at right angles to the 60-lb. felt, lapped 17 in. and turned up 5 in. above the level of the roof, on all the vertical surfaces.

Start at the low point of the roof with a one-half width sheet of the 14-lb. felt, then a full width sheet of the same felt laid flush with and entirely covering the one-half width sheet. Then lay full width sheets, setting the first so as to overlap the one-half width, starting sheet 2 in. and then exposing 15 in. of each succeeding sheet to the weather.

Mop the entire surface between plies with the asphalt cement, heated to flow freely, and roll the felts closely behind the mop so that no missing of asphalt can possibly take place. Approximately 30 lb. of asphalt shall be used per square for each mopping.

Nail the back edge of each sheet with the barbed nails, driven through flat tin caps, spaced 9 in. apart; the center line of nail heads to be approximately ¾ in. below back edge of sheet.

3. Flashing-Walls and all other elevations above roof surface shall be carried vertically at least 12 in. to provide for proper flashing. Roofing material shall be carried up 5 in. above level of roof on all vertical surfaces.

All flashings, except those around ventilators, standpipes, exhausts, etc., shall be composed of base flashing of special asbestos flashing material, approxi-

mately 10½ in. wide, cemented and nailed to vertical surface. Such flashings shall be counter-flashed with approved fibrous mineral and applied with a reinforcement of impregnated asbestos felt.

4. When the roofing is otherwise complete, cover the entire surface with a mopping of the asphalt cement, to be applied hot, using approximately 25 lb. to the square.

Asphalt Impregnated Asbestos Felt and Asphalt Cement Over Wood
Type "C1" (Class B)

Roofing composed of one layer approximately 60-lb., two layers approximately 14 lb., asphalt impregnated asbestos felt (the latter lapped 3 inches), and a minimum of 55 lb. asphalt roofing cement, per 108 sq. ft.

1. Lay sheets of asphalt impregnated asbestos felt weighing approximately 60 lb. per 108 sq. ft., directly over the sheathing. Lap the joints 3 in. and seal them with asphalt cement. Nail these sheets along the lap with barbed nails driven through flat tin caps, spaced 6 in. apart, and in parallel lines approximately 10 in. apart and approximately 10 inches from the laps; these nails to be spaced 18 in. apart and staggered. This 60-lb. felt shall be laid parallel to pitch of roof and turned up 3 in. above the level of the roof on all vertical surfaces, but not cemented to vertical surfaces.

Over the 60-lb. felt, edging strips composed of the flashing material shall be applied at eaves, and gable overhang, extending 4 inches on roof, cemented and nailed and turned down over and secured to facia, and projected ½ inch beyond to form a drip edge.

2. Mop the entire surface of the 60-lb. felt with the asphalt cement, heated to flow freely, and while the cement is hot, imbed into it sheets of asphalt impregnated asbestos felt, weighing approximately 14 lb. per 108 sq. ft., in single ply construction; this 14-lb. felt to be run at right angles to the 60-lb. felt, lapped 3 in. and turned up 5 in. above level of roof on all vertical surfaces.

Start at the low point of the roof with a one-half width sheet of the 14-lb. felt, then a full width sheet of the same felt laid flush with and entirely covering the one-half width sheet. Then lay full width sheets, overlapping the preceding ones 3 in., with balance exposed to the weather.

Mop the entire surface between plies with the asphalt cement, heated to flow freely, and roll the felts closely behind the mop so that no missing of asphalt can possibly take place. Approximately 30 lb. of asphalt shall be used per square for each mopping.

Nail the back edge of each sheet with the barbed nails, driven through flat tin caps spaced 9 in. apart; the center line of nail heads to be approximately ¾ in. below back edge of sheet.

3. Flashing walls and all other elevations above the roof surface shall be carried vertically at least 12 in. to provide for proper flashing. Roofing material shall be carried up 5 in. above the level of the roof on vertical surfaces.

All flashings, except those around ventilators, standpipes, exhausts, etc., shall be composed of the base flashing of special asbestos flashing material, approximately 10½ in. wide, cemented and nailed to vertical surface. Such flashings shall be counterflashed with approved fibrous mineral and bituminous cement and applied with a reinforcement of impregnated asbestos felt.

4. When the roofing is otherwise complete, cover the entire surface with a mopping of the asphalt cement, to be applied hot, using approximately 25 lb. to the square.

Asphalt Impregnated Asbestos Felt and Asphalt Cement Over Dry Concrete or Gypsum
Type "C2" (Class A)

Roofing composed of one coat asphalt primer, one coat asphalt cement over primer, one layer, approximately 60 lb., and two layers approximately 14 lb., of asphalt impregnated asbestos felt (the latter lapped 17 in.), and a minimum of 85 lb. asphalt roofing cement per 108 sq. ft., not including primer or first coat over primer.

1. Coat the concrete or gypsum with cold asphalt primer, using approximately 1 gal. over concrete and 1 to 2 gal. over gypsum per 100 sq. ft. of roof surface to provide a proper bond between roof deck and asphalt. Allow the primer to dry.

2. Mop the entire surface thus primed with asphalt cement, heated to flow freely, and while the cement is hot embed into it sheets of asphalt impregnated asbestos felt, weighing approximately 60 lb. per 108 sq. ft. Lap the joints 3 in. and seal them with the hot asphalt cement. The 60-lb. felt shall be laid parallel to pitch of roof and turned up 5 in. above level of roof on all vertical surfaces.

Over the 60-lb. felt, edging strips composed of flashing material shall be applied at eaves and gable overhand, extending 4 inches on roof, cemented and turned down over and secured to facia and projected ½ inch beyond to form a drip edge.

3. Mop the entire surface of the 60-lb. felt with the hot asphalt cement, and while the cement is hot imbed into it sheets of asphalt impregnated asbestos felt, weighing approximately 14 lb. per 108 sq. ft. in two-ply construction; this 14 lb. felt to be run at right angles to the 60-lb. felt, lapped 17 in. and turned up 5 in. above level of roof on all vertical surfaces.

Start at the low point of the roof with a one-half width sheet of the 14-lb. felt, and then a full width sheet of the same felt laid flush with and entirely covering the one-half width sheet. Then lay full width sheets, setting the first so as to overlap the one-half width, starting sheet 2 in. and then exposing 15 in. of each succeeding sheet to the weather.

Mop the entire surface between plies with asphalt cement, heated to flow freely, and roll the felts closely behind the mop so that no missing of asphalt can possibly take place.

4. On gypsum and other types of roof decks that permit of nailing, the back edges of all felts shall be securely nailed to roof slab with cut nails driven through flat tin caps in addition to mopping.

5. Flashing-Walls and all other elevations above roof surface shall be carried vertically at least 12 in. to provide for proper flashing.

Roofing material shall be carried up 5 in. above level of roof on vertical surfaces. All flashings except those around ventilators, standpipes, exhausts, etc., shall be composed of base flashing of special asbestos flashing material approximately 10½ in. wide, cemented and nailed to vertical surface. Such flashings shall be counterflashed with approved fibrous mineral and bituminous cement, and applied with a reinforcement of impregnated asbestos felt.

Note.—On concrete surfaces maximum pitch upon which this roofing may be applied without nailing is 3 in. to the foot, except on short runs, as in sawtooth construction. If wood nailing strips are inserted in concrete, the pitch may be increased.

Provision for expansion should be made in covering over expansion joints in concrete slab.

Asphalt Impregnated Asbestos Felt and Asphalt Cement Over Dry Concrete or Gypsum Type "C2" (Class B)

Roofing composed of one coat of asphalt primer, one coat asphalt cement over primer, one layer approximately 60 lb., and two layers approximately 14 lb. asphalt impregnated asbestos felt (the latter lapped 3 in.) and a minimum of 55 lb. asphalt roofing cement per 108 sq. ft., not including primer or first coat over primer.

1. Coat the concrete or gypsum with cold asphalt primer, using approximately 1 gallon over concrete and 1 to 2 gal. over gypsum per 100 sq. ft. of roof surface to provide a proper bond between roof deck and asphalt. Allow the primer to dry.

2. Mop the entire surface thus primed with asphalt cement, heated to flow freely, and while the cement is hot, imbed into it sheets of asphalt impregnated asbestos felt, weighing approximately 60 lb. per 108 sq. ft. Lap the joints 3 in. and seal them with the hot asphalt cement. This 60 lb. felt shall be laid parallel to pitch of roof and turned up 5 in. above level of roof on all vertical surfaces, but not cemented to vertical surfaces.

Over the 60-lb. felt, edging strips composed of flashing material shall be applied at eaves and gable overhang, extending 4 in. on the roof, cemented and turned down over and secured to facia and projected ½ inch beyond, to form a drip edge.

3. Mop the entire surface of the 60-lb. felt with the hot asphalt cement, and while the cement is hot, imbed into it sheets of asphalt impregnated asbestos felt, weighing approximately 14 lb. per 108 sq. ft. in single-ply construction; this 14 lb. felt to be run at right angles to the 60-lb. felt, lapped 3 in. and turned up 5 in. above level of roof on all vertical surfaces.

Start at low point of roof with a one-half width sheet of the 14-lb. felt, then a full width sheet of the same felt laid flush with and entirely covering the one-half width sheet. Then lay full width sheets, overlapping the preceding ones 3 in., with 29 in. exposed to the weather.

Mop the entire surface between plies with the asphalt cement, heated to flow freely, and roll the felts closely behind the mop so that no missing of asphalt can possibly take place. Approximately 30 lb. of asphalt shall be used per square for each mopping.

4. On gypsum and other types of roof decks that permit of nailing, the laps of the 60-lb. felt and the back edges of the 14-lb. felt, shall be securely nailed to roof slab with cut nails driven through flat tin caps in addition to mopping.

5. Flashings-Walls and all other elevations above roof surface shall be carried vertically at least 12 in. to provide for proper flashing. Roofing material shall be carried up 5 in. above level of roof on all vertical surfaces. All flashings except those around ventilators, standpipes, exhausts, etc., shall be composed of base flashing of special asbestos flashing material, approximately 10½ in. wide, cemented and nailed to vertical surface. Such flashings shall be counter-flashed with approved fibrous mineral and bituminous cement and applied with a reinforcement of impregnated asbestos felt.

When the roofing is otherwise completed, cover the entire surface with a mopping of the asphalt cement, to be applied hot, using approximately 25 lb. to the square.

Note.—On concrete surfaces maximum pitch upon which this roofing may be applied without nailing is 3 in. to the foot, except on short runs, as in sawtooth construction. If wood nailing strips are inserted in concrete, the pitch may be increased.

Provision for expansion should be made in covering over expansion joints in concrete slab.

Discussion

[The report was presented by Chairman Dorrance, the report consisting in large part of a practical rewriting of the subject matter in the Manual. No revisions having been made for a number of years, the work of revision, according to the introductory remarks of the chairman, consisting principally of the omission of all reference to ash pits and engine house design in the Manual, and, with reference to other subjects, such a rearrangement as would present the information in a more logical way.]

L. J. F. Hughes (C. R. I. & P.): I am speaking now in the interest of keeping the matter in the Manual as concise as possible. What I refer to particularly is the paragraph in which rest houses are discussed. It seems to me that while the material given in the paragraph marked "Purpose" is all very good, it is something that is somewhat out of the scope of buildings themselves. I merely bring this up as a suggestion to the committee.

Chairman Dorrance: The committee is glad to have such suggestions and will consider them.

[The recommended revisions were adopted for inclusion in the Manual, after which, successively, the report on specifications for railway buildings was received as information and those portions of the report on specifications for roofing and concrete be accepted for publication in the Manual. It was *moved and carried* that the specifications for roofing be accepted. *It was moved* that the specifications on concrete be accepted.]

Past President McDonald: The question now comes up on the motion to adopt specifications for concrete. This specification was objected to last year and was brought up by the Committee on Masonry. It is possible that the matter has been so amended as to remove the objections.

C. C. Westfall (I. C.): That objection still stands. The Masonry Committee is not in agreement with the Committee on Buildings on the procedure. It is not so much the material in the specifications as what should be done. I don't think it is professional jealousy, because after the Association has adopted a specification, it is the specification of the entire Association, the Building Committee as well as the Committee on Masonry.

If the Building Committee wants special provisions in addition to what are now in the Manual, it might supply those. In the specifications that are now offered by the Building Committee, such information as is included is almost entirely a copy of the specifications that now appear in the Manual. That appears to me to be a needless duplication and it burdens the Manual.

When this Building Committee referred to reinforcement they said that the material should conform to the A. R. E. A. specifications. When they referred to structural steel shapes, they said that that material should conform to the A. R. E. A. specifications. They call for brick and tile in the process of manufacture to conform, and it seems to me that concrete should be handled the same way.

The Building Committee should use in buildings the concrete that this Association has been willing to write a specification for. If they want to add something to it, they should provide for that additional thing.

I move that this entire matter on concrete specifica-

tions be referred back to the Committee on Buildings with instructions that all duplication and all conflict with the specifications that now appear in the Manual be eliminated.

The motion was seconded.

Past-President McDonald: Mr. Westfall, do you not think that this is really a question of jurisdiction and one that should be referred to the Board of Direction?

Mr. Westfall: I do, but the Board of Direction has not instructed the committee along those lines. The matter has been discussed and the committee has really tried to get a voice of the Board before this was brought up before the convention, as referred to by the Chairman of the Building Committee, and it seemed rather out of place to sort of fight it out on the floor, but that seemed the only way we could do it.

The Building Committee presented it for adoption for printing in the Manual; it was before the convention, and if somebody hadn't taken issue with them, it would have gone into the Manual and it would have been too late. It was withdrawn at that time and now it is presented again, and if it isn't stopped it goes into the Manual. I believe it has to be settled now or held in abeyance until the boys can act.

Past-President McDonald: The Chair suggests that you amend your motion, instead of withdrawing it, and refer it back to the Board of Direction to settle the question of jurisdiction.

Mr. Westfall: I will be very glad to do that.

Past-President McDonald: Unless there is objection, it will take that course. The matter will be referred to the Board of Direction.

Mr. Darrance: That concludes the report of the Committee on Buildings.

Past-President McDonald: Its work has been very arduous and it is a very difficult matter to ever get a report in the Manual that did not receive objections from somebody. I desire to compliment the committee on its good work and dismiss it with the thanks of the Association.

Report of the Special Committee on Clearances

THIS committee has not proceeded sufficiently far with its work to be able to formulate any recommendations for the action of the association. It has divided its investigations into four subdivisions, as follows: (1) Clearances required for electrical zones; (2) Limiting outline of clearance required for equipment; (3) Limiting outline of clearance required for lading, and (4) Clearances required for safety of trainmen. Sub-committees have been appointed to study each of these various sub-divisions. Three of these sub-committees have made their reports, which reports indicate that more information must be obtained and studied before recommendations can be made by the committee. During the past decade changes have been made in dimensions and types of equipment, in the sizes and weights of shipments, and in the clearances fixed by legislative acts of many states. The self-propelled gas-electric units that have come into use recently present special problems on clearances.

The committee recommended the re-assignment of the subject in its present form.

O. F. Dalstrom, chairman.

Closing Business

AT the conclusion of the presentation of the reports of the standing committees the convention proceeded to the consideration of new business. After the passage of the usual resolutions, J. L. Campbell, past president, presented Mr. Fairbairn with a silver loving cup in behalf of the association "in appreciation of your service to this association, as a visible token of its regard for you and a reminder as the years go by of the service that you have rendered this association." After responding to this presentation and thanking the association for its expression of appreciation, President Fairbairn asked Hunter McDonald and John G. Sullivan, past presidents, to escort C. F. W. Felt, president-elect to the platform, where he was installed as president. Mr. Felt then declared the convention adjourned at 3:20 p. m.

American Railway Engineering Association Registration

FORTY-EIGHT members and 22 guests registered at the convention yesterday bringing the total registration of members for the three days up to 831 and the guests to 199, a combined total of 1030. This compares with a total registration of 780 members and 208 guests or a combined total of 988 last year. The registration this year was the largest in the history of the association, this being the first time in which the registration of members exceeded 800 and the total exceeded 1,000. The names of those who registered yesterday follow:

Adsit, C. R., asst. div. engr., B. & O., Akron, O.
Baker, W. E., sup., Penna., Cleveland, O.
Baldwin, L. W., pres., M. P., St. Louis, Mo.
Barry, H. B., prin. asst. engr., St. L.-S. F., St. Louis, Mo.
Beatty, E. W., chair. and pres., C. P., Montreal, Canada.
Bishop, C. E., asst. engr., M. P., Poplar Bluff, Mo.
Bishop, F. J., asst. ch. engr., A. A., Owosso, Mich.
Boots, E. W., engr. main. of way, P. & L. E., Pittsburgh, Pa.
Brum, G. M., insp., C. R. I. & P., Chicago.
Burt, C. S., supt. ties & treat., I. C., Memphis, Tenn.
Clopton, E. J., sup., B. & O., Philadelphia, Pa.
Copeland, R. D., sup., Wabash, Chicago.
Cramer, F. H., asst. bridge engr., C. B. & Q., Chicago.
Denney, C. E., v.-p. and gen. mgr., N. Y. C. & St. L., Cleveland, O.
Gamble, J. S., sup., Wabash, Montpelier, O.
Gillam, W. R., roadmaster, I. C., Clinton, Ill.
Goos, J. H., insp. engr., G. N., St. Paul, Minn.
Hales, F. S., engr. of track, N. Y. C. & St. L., Cleveland, O.
Hart, R. P., asst. bridge engr., M. P., St. Louis, Mo.
Hatt, W. K., prof. of civ. engr., Purdue University, Lafayette, Ind.
Kenney, E. F., metallurgical engr., Bethlehem Steel Co., Bethlehem, Pa.
Kingman, W. A., of. engr., A. T. & S. F., Newton, Kan.
Lewis, O. A., bridge & bldg. sup., Wabash, Montpelier, O.
Lovejoy, L. P., asst. engr., Wabash, Moberly, Mo.
Lunday, C. G., v.-p. and gen. mgr., L. & A., Minden, La.
Montgomery, C. R., of. engr., M.-K.-T. Lines, St. Louis, Mo.
Oldshue, James, asst. engr., I. C., Chicago.
Olson, N. E., bridge draftsman, M.-K.-T., St. Louis, Mo.
Oyler, E. C., div. engr., Penna., Chambersburg, Pa.
Pelley, J. J., v.-p., op., I. C., Chicago.
Rawlings, J. H., asst. engr., M. P., St. Louis, Mo.
Russell, W. E., roadmaster, I. C., Champaign, Ill.

Scott, H. E., con. engr., Industrial Track Construction Co., St. Louis, Mo.
Searls, H. C., val. engr., M. P., St. Louis, Mo.
Seely, S. A., div. engr., N. Y. C., Utica, N. Y.
Smith, Huntington, of. engr., N. Y. C. & St. L., Cleveland, O.
Staley, G. L., asst. bridge engr., M.-K.-T. Lines, St. Louis, Mo.
Thrower, D. W., val. engr., I. C., Chicago.
Van Arsdalen, C. I., asst. engr., I. C., Carbondale, Ill.
Ward, T. J., sup. of bridges and bldgs., Wabash, Springfield, Ill.
Wildermuth, E. J., asst. engr., M. P., Kirkwood, Mo.

GUESTS

Andrews, G. N., I. C., Chicago.
Berman, J. P., Chicago.
Buckingham, C. C., engr. tests, M.-K.-T., Parsons, Kan.
Duckett, F. M., C. P., Montreal, Can.
Gehrke, E. G., Chicago.
Haupt, C. W., Strobel Steel Con. Co., Chicago.
Heap, J. O., sup., Penna., Philadelphia, Pa.
Horund, C. H., contractor, Chicago.
Kelly, T. W., roadmaster, A. T. & S. F., Guthrie, Okla.
Laird, E. C., editor, *Railroad Herald*, Atlanta, Ga.
McNellis, Frank, asst. secty., A. R. E. A., Chicago
Montgomery, G. C., Long Bell Lumber Co., Chicago.
Olson, J. N., asst. engr., A. T. & S. F., Chicago.
Otto, J. B., Jr., sup., Penna., Phillipsburg, N. J.
Sizeman, C. S., ch. tie insp., Memphis, Tenn.
Teal, D. C., instrumentman, C. & O., Peru, Ind.
Tesk, M., asst. engr., Wabash, Montpelier, O.
Walker, P. O., A. T. & S. F., Guthrie, Okla.
Walter, W. R., gas engr., St. L. S. F., Springfield, Mo.

In Recognition of Julius Kruttschnitt

As a token of appreciation of the value of the service rendered the Engineering division of the American Railway Association by the late Julius Kruttschnitt, chairman of the Executive committee of the Southern Pacific company, who died on June 15, 1925, the officers of the Engineering division of the American Railway Association adopted appropriate resolutions, Mr. Kruttschnitt being the official representative of the American Railway Association on the board of directors of the Engineering department at the time of his death. The resolutions were engrossed and handsomely bound in leather and presented to the family of Mr. Kruttschnitt. These resolutions are reproduced herewith.

Julius Kruttschnitt

Chairman, Executive Committee
Southern Pacific Company

Died June fifteenth
Nineteen hundred twenty-five
in his seventy-first year.

It is befitting that the Engineering Division of the American Railway Association with which he was intimately identified as its Official Representative on the Board of Directors, make record of its lasting obligation for his services in the cause of the Science of Railway Engineering, and set forth an estimate of his character and his accomplishments.

His connection with this Division was made in its early organization. The story of its progress cannot be made without recording his individual part therein. The impress of his character, of his method of his thoroughness, and of his conscientiousness, is deep and lasting.

The Science of Railway Engineering, as expressed in the records of the Engineering Division reflects his painstaking genius, his wise forethought and his sound business sense.

As a leader in the organization he had the courage of his experience, and the quiet force which induced conviction.

In his varied relations to the work of the Engineering Division his simple character, his modesty, won the enduring regard of his co-laborers in our cause.

To those who were near and dear to him, the Engineering Division tenders its profound sympathy.

The keeness of their grief is tempered by the consoling reflection that the memory they cherish is not alone sweet to the senses of their affection, but in that wider circle where his life's work was accomplished, the fragrance of his memory will forever linger.

Chairman
Engineering Division
American Railway Association

E. H. Fritch
Secretary

The Resolutions Adopted by the Officers of the A. E. R. A. in Appreciation of the Late Julius Kruttschnitt